OUR WONDER WORLD

A LIBRARY OF KNOWLEDGE

In Ten Volumes

I. THE WORLD AND ITS PEOPLES

II. INVENTION AND INDUSTRY

III. THE NATURE BOOK

IV. EXPLORATION, ADVENTURE, AND ACHIEVEMENT

V. EVERY CHILD'S STORY BOOK

VI. SPORTS AND PASTIMES, INDOORS AND OUT

VII. AMATEUR HANDICRAFT

VIII. STORY AND HISTORY

IX. THE MOTHER'S HOME BOOK

X. THE QUIZ BOOK

Vol. 4

A CLOSE CALL

OUR WONDER WORLD

A Library of Knowledge

IN TEN VOLUMES

CHICAGO BOSTON
GEO. L. SHUMAN & CO.

THE UNIVERSITY PRESS, CAMBRIDGE, MASS.
THE BOSTON BOOKBINDING COMPANY, CAMBRIDGE, MASS.

VOLUME FOUR

EXPLORATION, ADVENTURE,

AND

ACHIEVEMENT

He must go — go — go away from here!
On the other side the world he's overdue.

KIPLING

EDITOR'S INTRODUCTION

EXPLORATION, adventure, achievement — the three are linked by a tie of spirit, the spirit which inspires them. This it is which prevents man from becoming a creature of habit and routine, driving him forth from his comfortable fireside to "the other side the world," where the feet of Kipling's young men tell them they are overdue. It has been our interest to group in this volume certain phases of history, biography, engineering, and scientific achievement as they have been dominated by this eager, unconquerable spirit which is making man master of the world.

The spirit of adventure gripped the Viking lad as he grew to manhood, and he sailed out into the unknown, tossing a feather into the air to see in which direction he should turn the prow of his vessel. It sent Columbus from court to court of Europe, trying to convince kings and queens that his dream of a direct passage to the Far East could be proved a reality. It has carried men of adventure through daring feats and brilliant exploits to the twentieth century, when the story of exploration spells also the record of achievement, when the map of the world is not only outlined but largely filled in, when the North and South Poles have both been visited and the dream of centuries accomplished; and yet even now Stefánsson, spending a winter in the far north, comes upon a tribe hitherto unknown to the white man. The story of adventure and exploration is by no means complete.

Parallel with this record of discovery runs the story of what man has accomplished during these centuries of occupation of the globe. Wherever the foot of the explorer has trod or the hand of the colonist been lifted, the face of the world has been changed. Man's buildings have progressed from tree nests to skyscrapers, his bridges from swinging boughs to webs of steel, his means of transportation from pack animals and from canoes hollowed out of logs to limited express trains and ocean liners. Where once he traveled by wooded paths, walking around every obstruction, he has constructed broad highways and tunneled mountains.

The skill of the engineer has carried on the work of the explorer. It has taken the scientist and the man of medicine to round out the story. While these men were adventuring in the far quarters of the world, scientists were working in their laboratories, testing, calculating, and experimenting, and physicians were studying with infinite patience the laws of health and disease. Each group worked along its own lines and in its own way. The twentieth century sees their forces combined and the

impossible accomplished. Balboa and Count de Lesseps could dream of and attempt a Panama Canal; it took the medical knowledge of to-day to carry it safely through to completion. The modern explorer goes out to his successes equipped with the instruments and knowledge of the latest science.

Because it is good for us to catch the spirit of achievement as well as to learn of its final results, we have tried to bring our readers into close contact with the men as well as with their work. We have pictured the early explorers as telling their own story, and given Captain Scott's own final records. We have told the story of achievements in building, railroading, and shipbuilding, and concluded each carefully verified account with the latest word of an expert: Frank Chouteau Brown giving from an architect's point of view the achievements in modern architecture and city planning; Professor Theodore H. Taft describing the railways of to-day; and Professor Henry H. W. Keith, the wonders of a battleship. James M. Barker, a recognized expert in engineering, writes the chapters on "Bridges and Bridge Building," "The Panama Canal," and "Other Marvels of Modern Engineering"; Dr. Williston W. Barker has made a summary of "Modern Medical Progress"; Dr. Harry M. Haynes has contributed "A Word about Dentistry"; and Paul P. Foster, an editor who makes it his business to keep in close touch with foreign as well as American advances in science, has touched on some of the most striking features of "Recent Scientific Progress."

History takes on a new meaning and life a new purpose as we catch the enthusiasm and inspiration of this story of man's achievement.

ACKNOWLEDGMENTS

In the division on "Exploration and Adventure" in this volume we have been fortunate in securing from other publishers selections and illustrations which could be adapted to our use as follows:

W. & R. Chambers, Edinburgh, text and illustrations from "Heroes of the Polar Seas," by J. Kennedy Maclean (published in America by J. B. Lippincott & Co., Philadelphia), on pages 55–66.

John Grant, Edinburgh, text and illustrations from "Thirteen Years among the Wild Beasts of India," on pages 122–129, 131, and 133.

William Heinemann, London, text and illustrations from "In the Forbidden Land," by A. Henry Savage Landor, on pages 135–138.

T. C. & E. C. Jack, London, illustrations from M. B. Synge's "A Book of Discovery" (an excellent and comprehensive volume on the progress of exploration), on pages 2, 4, 5, 9, 13, 20, 27–30, 32, 46, 52, 53, and 135.

McBride, Nast & Co., New York, illustrations on pages 79 and 159.

F. R. Niglutsch, New York, illustration on page 108.

Seeley, Service & Co., Ltd., London, text and illustrations from "Adventures in the Great Deserts," "Adventures among the Wild Beasts," "Adventures on the Great Rivers," and "Heroes of Missionary Enterprise" (published in America by J. B. Lippincott & Co., Philadelphia), on pages 70–73, 78–84, 130–134, 136, 139–161.

Frederick A. Stokes Company, New York, illustration facing page 26.

We are also indebted to "The Sphere," London, for its remarkable series of pictures illustrating Captain Scott's expedition, on pages 173–183.

CONTENTS

VOLUME IV

I. Exploration and Adventure

II. Achievement

FULL-PAGE ILLUSTRATIONS

In addition there are 192 illustrations in the text, of which those with titles are catologued under their respective subjects in the General Index in Volume X.

THE MOUNTAIN TRAIL

MAKING THE MAP OF THE WORLD

"WHO'S WHO" IN EXPLORATION

WHAT KIND OF STUFF EXPLORERS AND DISCOVERERS ARE MADE OF, AND WHY THEY ARE ADMIRED OF MEN

SO long as there is land or water unexplored, so long there will be explorers, for there are born in every age some men who cannot rest content while anything remains unknown. The spirit of discovery has always been found among men, and there is no finer record of courage and endurance than that of the adventurous leaders who have made the world known by going at any risk and cost to explore it.

If you would know what kind of stuff these pioneers were made of, the records tell it: "We ate biscuit, but in truth it was biscuit no longer, but a powder full of worms; so great was the want of food that we were forced to eat the hides with which the mainyard was covered; but we had to make use of sawdust also for food, and rats became a great delicacy." That was Magellan's experience, as he steered his little ship across the untracked Pacific. We see Sir John Franklin returning from the Arctic coast, stilling the pangs of hunger with "pieces of singed hide mixed with lichen," varied with "the horns and bones of a dead deer, fried with some old shoes."

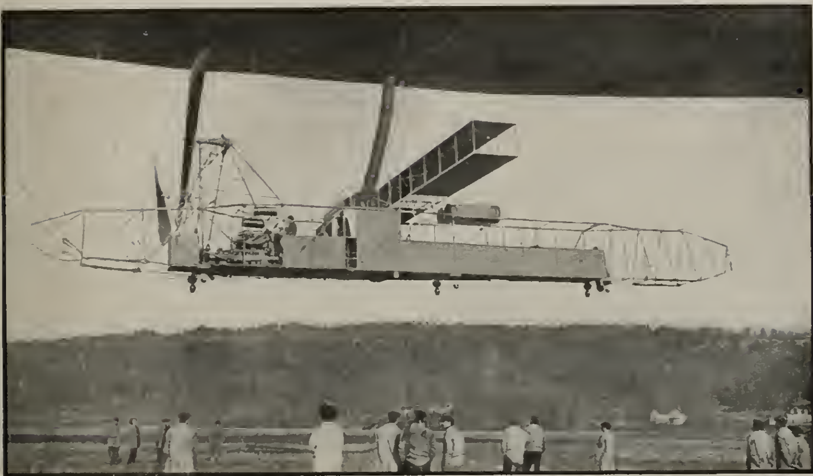
"Having eaten our shoes and saddles boiled with a few wild herbs, we set out to reach the kingdom of gold," says Orellana in 1540. Remember there was no land map or ocean chart to guide these explorers; there were no lighthouses along the coast and nobody knew whether there was any coast; there were no books of travel or discovery to describe real or imaginary lands and peoples. Yet the Englishmen of the sixteenth century had the true temper of all explorers — the temper that has mapped the world and discovered the continents — when they said, as they set out to take possession of the North, "There is no land uninhabitable, nor sea unnavigable." These world explorers were as hearty as they were brave. Monarchs in their crazy little wooden ships, which were smaller than a Gloucester fishing smack and almost invisible beside a fifty-thousand-ton steamship like the *Imperator*, these dauntless mariners faced every conceivable danger with light heart. No wonder we like them, and like to read their stories, which are the true romances! Who with red blood can fail to admire the spirit that carried Columbus across unsailed seas and enabled him to cow mutinous crews; that nerved Vasco da Gama to double the Cape of Storms; that led Magellan to pass through the dreaded Straits which perpetuate his name; that made Livingstone the opener-up of Dark Africa; that in our own day held a Peary on his frozen way till he planted the stars and stripes where the North Pole would be if there was any; that kept Amundsen to his South Pole quest till he arrived; and that sustained the lamented Captain Scott on his journeys across the ice-fields of the Antarctic, nor forsook him in the tent where in blizzard snowsheet he penned his last and unrivaled record and lay down to die as only a brave man could? With these men we are in companionship with the world's bravest, hardiest, and truest, and it is good company to travel in.

A WORD ABOUT WHAT WAS KNOWN AND UNKNOWN BEFORE THE EXPLORERS STARTED

We have our geographies, maps, and atlases now, but what did the men of old know about the earth before the first geography was made? It was certainly a pretty small world that any one group of people knew. The common theory was that of a flat world, with mountains at either end, on which rested a solid metal dome known as the "firmament." In this shining circle were windows, in and out of which the sun would creep by day and the moon and stars by night. This world was balanced on the waters, and it was all a wonderful piece of work, which few men cared to pry into. Remember Homer's idea of the world as a round plate, pictured in Volume I (page 2), and also that this "flat earth" theory persisted for centuries and was common till the sixteenth century. The theory of the earth as a globe, however, goes back to Aristotle (384–322 B. C.), and scientific men accepted it more and more. But as to the extent of land and water, and how the land lay, the ignorance was dense enough, so that Columbus, as we know, thought he could sail across the Atlantic and reach Japan in three thousand miles, not having the slightest notion that a three-thousand-mile continent and another four-thousand-mile ocean lay between Spain and China. Look at the early maps, and you will see how little was known when the real explorers began; while they did not even have the magnetic compass to sail by until the twelfth century, when the Crusaders brought it back with them from Arabia. Lacking scientific instruments, such as the sextant and marine chronometer, it is all the more wonderful what these glorious sailors accomplished. Remember this, as you enjoy the stories which the Explorers' Club will now bring to you, by the unusual route of the canal-cut Planet Mars.

PTOLEMY'S MAP OF THE WORLD, ORIGINALLY DRAWN ABOUT A. D. 150

From the first printed edition of 1472, the first book having printed maps. Compare this map with a medieval map, such as the Hereford map of the world, made eleven centuries later, and you will see the extraordinary accuracy and value of Ptolemy's geography. The British Isles form a dark section in the left upper corner. Other dark sections are Africa, Arabia, and India.



THE EXPLORERS' AND DISCOVERERS' CLUB, LIMITED

GREAT NIGHTS IN THE HISTORY OF AN ORIGINAL AND UNIQUE CLUB, MADE UP OF THE TRULY RENOWNED, WHO TELL WHY THEY HAVE A RIGHT TO BELONG, AND THUS QUALIFY FOR MEMBERSHIP AMONG THE IMMORTALS

OUR airship could not have reached Mars in a happier time, for we had no sooner begun to feel at home on the Planet, whose people were full of hospitality, curiosity, and kindness, than I saw an announcement of a meeting which aroused my curiosity and keen interest. It was to be the first meeting of the Explorers' and Discoverers' Club, Limited. I asked my Martian host about it, and he said that he was one of the originators of the club, and if I was interested he could assure me of admittance to the meeting. The idea had been suggested by a Martian explorer that a Universal Club, to include all real map makers and continent discoverers and travel pioneers, should be organized, and that each applicant for membership should appear in person to make good his claims to a seat among the Immortals who had added something to the World's Map, and had become known by discovering the Unknown. The idea had met with hearty welcome, and the applicants had gathered from different parts of the Universe and were to recount their adventures before the high tribunal of judges duly appointed. That very night was to be the beginning of what must prove an eventful series of stories, more entrancing than the Arabian Nights.

How great was my good fortune to be included in the wonderful company will be seen by the reader who shares with me the remarkable experiences of the Great Nights with the most daring men our world has produced. We have read of them, but who could dream of hearing them recite their own adventures after all these centuries? But they do not keep time on the other planets as we do, and travel is only a matter of thought and wish, while old age is unknown. Let us hasten to the meeting.

It is difficult to describe the banquet hall, so beautiful was it, so perfect in all its appointments. None of our palaces have its equal. Around the tables gathered the brilliant company, the men marked by dignity and fine courtesy, the ladies crowned with beauty and grace. Think what a group of men that was sitting at the raised table of honor! There

was Columbus at the right of the presiding judge, and Marco Polo on his left; while on either side were Herodotus and Xenophon, the Greek travelers and historians; Alexander and Cæsar, world conquerors; a St. Patrick and St. Columba, Leif and his father Erik the Red, Ibn Batuta the Moor, Bartholomew Diaz and Amerigo Vespucci, Vasco da Gama and Balboa, Cortes and Cabot, Cartier and Drake, Davis and Hudson, Champlain and Behring, Vancouver and Mungo Park, Ross and Franklin, Livingstone and Speke, Nansen and Peary, Amundsen and Scott. What converse would be theirs! Men of far-apart centuries and circumstances and climes, but all alike in the heroic qualities of character and in having done something worthy of universal honor. Of course, besides these great leaders, there were scores of lesser lights in exploration.

It was indeed a gallant and great company, and the air was tense with interest. As an arrival by the new means of communication that had proved it possible for Earth and Mars to have intercourse, I was given more attention than of right belonged to me, and found that the discoverers who had dared most on the sea were greatly concerned to learn about the experiences in the air, which they said must be vastly more perilous and nerve-racking. I was enjoying the opportunity to study the faces of the chief explorers when the Supreme Judge sounded the silver bell for silence. It was fitting, he said, that he should open this first meeting of the new club with an expression of the delight of all Martians at the success already achieved in bringing together around the festal board such a distinguished body of men as had never before been gathered under one roof. After paying a fine tribute to the spirit of faith and courage that had ever marked the explorers, he announced the decree that each member upon election should, in place of any ordinary form of initiation, relate his story, in order that he might take his proper rank among the Immortals.

Turning to the stately courtier on his left, he said it was his high privilege to present, as the first member-elect, the noble Venetian, Marco Polo, who had added Asia to the map, and been the first to make China and Japan known to men. The Venetian arose, clad in the rich costume of the thirteenth century; and when the round of applause had subsided, in musical tones he told his tale.

THE "DAUPHIN" MAP OF THE WORLD

Made in 1546 for the Dauphin (Henri II of France) by order of Francis I. It shows the geographical knowledge of the first half of the sixteenth century. North of the Equinoctial the map is reversed. Canada is claimed for France.

MARCO POLO, FROM AN OLD PRINT

THE STORY OF MARCO POLO

IN WHICH THE VENETIAN TELLS HOW HE ADDED CHINA AND JAPAN TO THE MAP OF THE WORLD

IT seems scarcely fitting that in this brilliant company, I, who have no such story of daring and suffering to tell as others present could truthfully narrate, should be the first to speak; but I bow to the mandate of the Judge. That I became a traveler was due to my father, Nicolo Polo, and his brother Maffio, my good uncle. In 1254, the year of my birth, rumors came to Venice of the wealth of the mysterious land of Cathay, and my uncle and father, taken with the fever of travel and hope of gain, started on a trading enterprise to the East. Having come "with a fair wind and the blessing of God" to Constantinople, they sold much goods at profit; then directed their course to Bokhara, in Persia, where they fell in with a Tartar nobleman who persuaded them to go on with him to the Court of Kublai Khan, the most famous ruler of China. It took them a year to reach Peking, which they regarded as the end of the world eastward, and there they were cordially received by the Great Khan. He was eager to know all about their country and religion, and also wished them to remain with him. After some years he decided to send messengers to the Pope, asking for a hundred wise men to teach Christianity to his people. For this mission he chose my father and uncle, and they started homeward, armed with golden tablets which acted as passports through all the Khan's dominions. The Pope's death delayed them, so that they reached Venice when I was fifteen, and ready to become wild with enthusiasm over their stories of the Far East and the Court of the greatest emperor on earth. When they were ready to set out for their second journey to China, they told me I was to go with them. My cup of joy was full. My one desire was to see the world and to share in adventure.

We journeyed through Armenia and Persia, where I fell ill of a fever, delaying our party nearly a year. When able to go forward, I saw Mount Ararat, where Noah's ark rested after the Deluge, and also noticed large supplies of

THE BROTHERS POLO LEAVING HOME

"a liquor like oil, which is good for burning" (the first discovery of petroleum wells). I must not weary you with our three and a half years of travel before we reached the Court of the Great Khan at Shangtu, the imperial summer

MARCO POLO AT A FEAST OF KUBLAI KHAN IN HIS PALACE IN PEKING

palace in the mountains. On the way we had some exciting experiences, being greatly hindered by snow and floods and bitter weather, as we crossed the great highlands of the Pamirs, the "roof of the world," where white men had not been before. The great Gobi Desert held us for thirty days in its sandy wastes, and welcome indeed were the Khan's messengers who met us on its borders. It was after a tremendous journey of a thousand days that in May of 1275 we reached the Khan's hospitality. "The lord of all the earth" received us most kindly, giving me special welcome as my father's son.

On the way I observed some unusual things, such as the turquoise mines of Kirman, the swift horses, the great oxen, white as snow, the wonderful birds, the abundance of fruits, the precious stones, and the quaint customs of the people.

IN WHICH TWO WONDERFUL CITIES AND THE GREAT KHAN ARE DESCRIBED

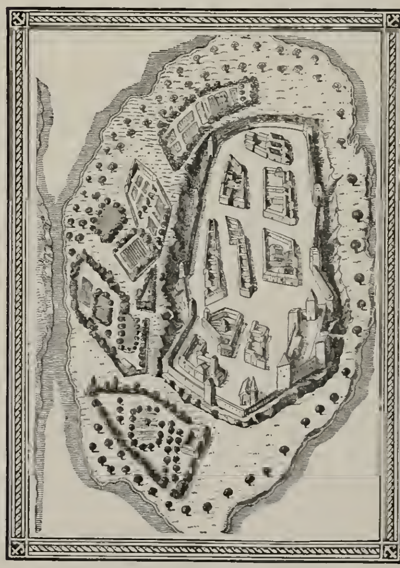
That we liked the Chinese you may know, since we remained at the Court of the Great Khan for seventeen years, and had hard work to get away then. I have been accused of telling some pretty large stories, and I am aware that in Venice, when anyone tells an incredible tale, it is called a Marco Polo; but this is most unjust, for I did not exaggerate or invent. It was my fortune to be in much favor with the Great Khan, who sent me on various quests, and heaped honors and riches upon me far beyond my deserts. He was indeed a remarkable man, this "lord of lords," named Kublai; he was of middle stature, neither too full nor too short; he had a beautiful fresh complexion, his color was fair, his eyes dark. His capital, Peking, had been rebuilt but a little while before our arrival, and was in the form of a square, six miles on each side, surrounded by walls of earth and having twelve gates. It was a wonderful city. The streets were so broad and straight that one gate could be seen from another. It contained many beautiful houses and palaces, and a very large one in the midst, having a steeple with a large bell which at night sounded three times, after which no man must leave the city. At each gate a thousand men kept guard, not from dread of any enemy, but in reverence of the monarch who dwelt within it, and to prevent injury by robbers.

But greater even than Peking was Hangtcheou-fou, the City of Heaven, in the south of China. And now I will tell you all its nobleness, for without doubt it was the largest city in the world. It was one hundred miles in circumference and had twelve thousand stone bridges, and beneath the greater part of these a large ship might pass. And you need not wonder there were so many bridges, because the city was wholly on the water and surrounded by it, like Venice. The merchants were numerous, and rich beyond belief. Their ladies were of almost angelic beauty. The people were idolaters, used paper money, ate the flesh of dogs

MARCO POLO IN CHINESE FORESTS

MEETING A GIANT OSTRICH

KUBLAI KHAN'S PALACE IN PEKING



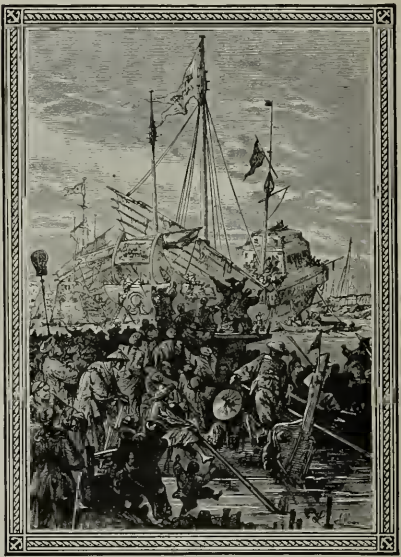
VIEW OF QUILOA, AS MARCO POLO SAW IT

and other beasts, such as no Christian would touch. There were in the city four thousand public baths, large and elaborate, in which all the people took great delight. This was like no other city I have ever seen.

It was not strange that we enjoyed life with the Great Khan, for he gave splendid festivals, at which forty thousand persons feasted, the Khan himself being served only by his great barons, their mouths wrapped in rich towels embroidered in gold and silver, that their breath might not blow upon the plates. His presents were on a colossal scale; it was no rare occurrence for him to receive five thousand camels, a hundred thousand beautiful horses, and five thousand elephants covered with cloth of gold and silver. And now I will relate a wonderful thing. A large lion was led into his presence, which, as soon as it saw him, dropped down and made a sign of deep humility, owning him as its lord and moving away without any chain. His provinces numbered thirty-four, and his messengers on all the roads found at every twenty-five miles a post, with bed, food, horses in waiting, and everything needful for their comfort. Foot runners also bore the royal dispatches, after the fashion of a relay race. Thus the Great Khan would send to all his provinces to know if any of his subjects had lost their crops through bad weather; and, if so, he did not exact tribute for that season, and even gave them corn out of his own stores to subsist on.

A curious discovery which I made was that throughout China there was a kind of black stones cut from the mountains in veins, which burn like logs (coal). They kept fire better than wood, and were cheaper. This fuel was used throughout Cathay. I should like to tell of the wealth of mulberry trees on which lived the silkworms that made the land famous for its silks; the marvelous stone bridge over the Yellow River, with its twenty-four arches of pure marble; the exquisite porcelain ware made from earth exposed to the action of the atmosphere for forty years, and of many other things I saw; but I must hasten on with my too long story, lest I weary your patience.

I suppose I may claim to have added the islands of Japan to the map of Europe, since I was the first European to visit those islands, fifteen hundred miles from the coast of China. Zipangu, as we called Japan, was inhabited by people white in color, of fair and civilized manners, gentle, idolaters in religion, with a king of their own. Their land was full of precious metals. The Great Khan had attacked them with his fleet in 1264 and took their gold for his palace, but he would allow no one to export it. It was part of my duty while subject of the Great Khan to make warlike explorations into new provinces, such as Tibet, and the whole southeast of Asia from Canton to



KUBLAI KHAN EQUIPS A FLEET

Bengal. But I was always glad to get back to my adopted Chinese home, the richest and most famous country of all the East.

IN WHICH RETURN IS MADE TO VENICE, AND SKEPTICAL KINSFOLK ARE CONVINCED BY A CLEVER RUSE

At last my uncle, father, and I became homesick, and desired to see our own Venice once more. The Khan was not willing to let us go, but our chance came when the ruler of

wished to marry a princess of the house of Kublai Khan, and it was decided to send the lady by sea under an escort. Of course we were the only ones who knew the route, and so in 1292 we set sail with an escort of fourteen ships for India, having the little princess of seventeen and her suite under our protection. After three months at sea we reached Java, which I supposed to be the greatest island in the world, above three thousand miles around. Bad weather held us five months at Sumatra, but at last we reached the Bay of Bengal; and a thousand miles west of that came to Ceylon, certainly the finest island in the world. It was not till two years after leaving Cathay, however, that we reached our destination, only to learn that the ruler of Persia was dead. We gave the little princess to his son for bride, and passed on by Constantinople to Venice, arriving in 1295.

What was our unpleasant surprise to discover that our relatives and friends did not recognize us, and would not believe that we were the Polos who had left Venice twenty-four years before. No one credited our story. Then I planned a ruse. We made a sumptuous feast and invited our kinsfolk and some friends. When the hour for sitting down to table arrived, we came forth from our chamber all three clothed in crimson satin, fashioned in

MARCO POLO LANDS AT ORMUZ

long robes reaching to the ground, according to custom. When water for the hands had been served and the guests were set, we took off these robes and put on others of crimson damask, ordering our first suits to be cut up and divided ~~ng the servants. After partaking of some of the dishes, we went out again and came back in robes of crimson velvet, and had the second suits divided as before. Our Chinese court dress caused much wonder, but my stroke was yet to come. When the cloth had been drawn and all the servants had retired from the hall, I rose and went into a chamber, returning with the three shabby dresses of coarse stuff which we had worn when we first reached home. Straightway we took sharp knives and began to rip up some of the seams and welts, and to take out from them jewels of the greatest value in vast quantities, such as rubies, sapphires, carbuncles, diamonds, and emeralds, which had all been stitched up in those dresses in so artful a fashion that nobody could have suspected the fact. The sight of such wealth dispersed every doubt, and soon all Venice was seeking to do us honor. I was named "Il Milione," the Man of Millions, for the reason, I suppose, that I was always speaking of the Khan's millions of people and money; but I enjoyed the wonder our stories excited. I doubt, however, whether I should ever have put the tale into a preservable form had it not been for that fortune of war which made me a prisoner of the Genoese, and gave me in my enforced idleness the Pisan Rusticiano for a fellow-prisoner, he urging me to let him take down my travels by dictation. And I can only repeat now what I said with my last breath, when my friends asked me to remove from my story all that was not fact, that I had not told the half of what I had seen. As to the truth of one report I should be glad to know — that my story was one of the means that induced the great Columbus, master of us all, to give his life to exploration. That would be honor indeed (inclining his head to the courtly Genoese, who bowed).

Thus ended the first evening of the Explorers' Club, amid enthusiasm and congratulation. If the first of our Explorers' Nights was so interesting, what shall be said of the second, when it was known that the chief discoverer would be the speaker? He had no introduction. When the Judge rose, the entire company rose with him, and he simply said, "Christopher Columbus," while the air resounded with applause and cheers, and the great Italian stood for a moment in silence, then modestly began.

THE BOY COLUMBUS

From a statue by Giulio Monteverde.

COLUMBUS LANDING ON THE ISLAND OF SAN SALVADOR AND PROCLAIMING THE SOVEREIGNTY OF SPAIN

THE STORY OF COLUMBUS

IN WHICH THE GREAT GENOESE TELLS OF HIS BOYHOOD AND NARROW ESCAPE

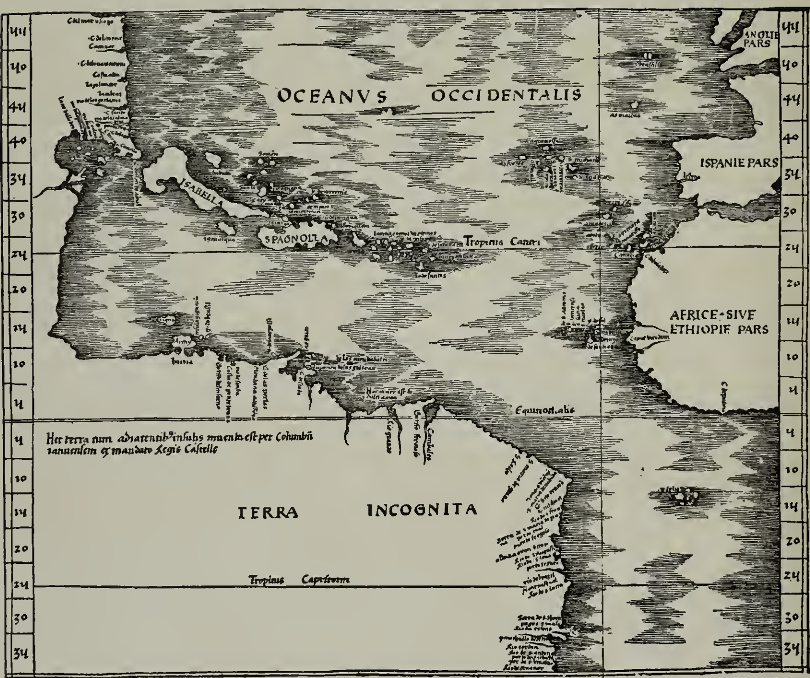
I DO not recall anything special about my boyhood except my love of the sea. Our home was not far from the water, and if ever I was missed, my brothers were sent to look for me along the quays, where I was sure to be found listening to the sailors or studying the white-winged caravels, which I knew every one by name, if it belonged to our port of Genoa. My father wanted me to be a weaver, like himself, but it was of no use. I was born for the sea, and was like a fish out of water until fourteen, when I shipped for my first voyage. But I had some taste of school before that, and was fond of my books, doing my Latin grammar fairly, but joying in geometry, astronomy, and navigation. If I was to be a sailor, my father did not intend me to be an ignorant one. And I was ever of an inquiring mind. I wanted to know all about a ship, and the instruments of navigation and maps and charts. I reveled in the stories which the sailors told of their voyages to distant and wonderful parts, and cannot remember when it was not my dream to discover some unknown land. It is quite true that the wonderful things told by Marco Polo had not a little to do with inflaming my imagination and impelling me to seek Cipango.

It was my lot to do some fighting as well as sailing, for the seas were not safe in those days, and the Venetians and Genoese were quarrelsome neighbors. I remember one very close call I had, when as a young man I had been put in charge of a ship, and had come to close quarters with a huge Venetian galley, grappling it with intent to board. Just then some hand-grenades, thrown by the Venetians, set both vessels afire, and there was nothing to do but to swim for it, with the shore some six miles away. My fighting harness was no help to keep afloat, but I was a powerful swimmer, and happily came upon an oar, with the aid of which, and my strong determination not to die before I had discovered India, I managed to reach the shore. That was the narrowest escape of my life, I think.

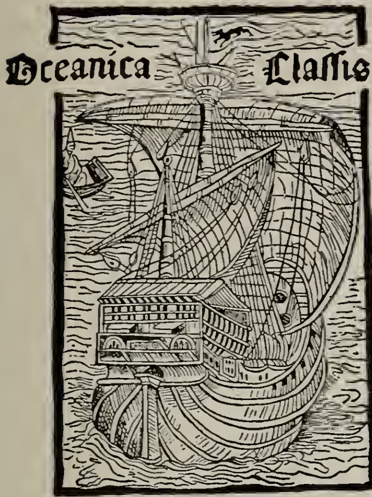
IN WHICH THE BOY BECOMES A MAN, MEETS WITH DISAPPOINTMENT IN PORTUGAL, AND FINDS SUPPORT IN SPAIN

From the age of fourteen to twenty-eight I spent most of my time on a ship, with Genoa as my home port. I sailed to as far-distant points as possible — east, west, and north, — for from boyhood I carried the idea of reaching India by sailing westward. Finally, I decided to seek my fortune in Portugal, because there were the more daring mariners, who did not hug the coast as our Genoese did. So in 1474 I left Genoa for Lisbon, where I could learn the latest news about explorations, and have better chances for sea-going. I made voyages to Guinea, Madeira, and England, so that I could truly say that before I was forty I had sailed to every part that had ever been sailed before. I married in Lisbon, and there set up, with my brother Bartholomew, who had traveled much with me, as map maker and practical navigator, having some distinction in that line. To make both ends meet I also made picture books and globes. I gave close study to all the maps and charts at Lisbon, and to the instruments for making observations at sea. Curious enough our maps were, as it seems now, but I took special interest in one that came to my notice, drawn by the Italian Toscanelli, who had the same idea I had cherished so long — of a westward route to India. His map became my chief treasure, as he did my best friend, and I owe much to both for whatever success came to me in discovery.

Presently came the news of the wonderful



THE ADMIRAL'S MAP, FROM THE STRASSBURG PTOLEMY OF 1513 (REDUCED)



VERY OLD PRINT OF A CARAVEL

voyage of Bartholomew Diaz, who had sailed around the south point of the continent of Africa, amid such perils as made him name it the "Stormy Cape," though the King of Portugal changed it to the "Cape of Good Hope," for the encouragement of other mariners. Lisbon was full of excitement and joy. In the flush of it, I was more determined than ever to try my fortune as an explorer. I had a good case to present to the king. One had told me of strange plants washed ashore on the Azores, another of curiously carved timbers picked up far out at sea; another of lands sighted in the far distance by mariners driven out of their course by storms. According to Toscanelli, a voyage of about 3250 miles would bring a ship from the Canaries to Cipango, or Japan, and that was not a distance to discourage one.

It was in 1480 that I first approached King John II of Portugal with my bold scheme and asked for an expedition. He was plainly caught with the idea, but said he would have to refer to his geographers, who readily declared my project impracticable. The king now tried to trick me. It was suggested to him that he might send out a vessel secretly to see whether my theory was true, and, if Asia were reached, His Majesty would have the glory all to himself; while otherwise, much expense would be saved. A caravel was actually sent into the Atlantic, with my charts and instructions in the captain's hands; but he looked upon the venture as a wild goose chase, and at the first storm turned back to port. I soon learned what had been done, and that determined me to leave Lisbon for a more honest place. I went straight to Spain, but only to find the sovereigns there in the final struggle against the Moors, so that expeditions were not then to be thought of, eager as Queen Isabella usually was on that subject. I sent my brother Bartholomew to England and France, to see if there was any chance in those quarters; but in vain. Still I could not give up. My plan possessed me day and night. I followed the sovereigns from camp to camp, I suffered every sort of privation and disappointment for five long years, but persisted, and at length got Queen Isabella's attention and interest. She promised to give me audience as soon as the city of Granada was captured, and when this occurred on January 2, 1492, she was as good as her word. The result was favorable. An agreement was signed by her, granting to me and my heirs the office of admiral in all continents and islands I might discover in the ocean; to myself the viceroyalty of all islands and continents; and one tenth of all the articles found, bought, or bartered within my jurisdiction. I had also the right to contribute one eighth of the expense of fitting out any expedition and of receiving one eighth of all profits.

IN WHICH THE EXPEDITION STARTS TO CROSS UNKNOWN SEAS, AMID GENERAL GLOOM

The queen was so enthusiastic that she said she would pawn her jewels, if necessary, to provide the supplies. Our little fleet was made ready, and I was the happiest man living. It is true the caravels were small: the *Santa Maria*, my own vessel, a hundred tons, with high poop and forecastle; the *Pinta*, fifty tons, and the best sailer; and the *Niña* (baby), forty tons; but nothing daunted me, not even the motley and unwilling crew, ninety all told. I cannot say that it was a cheerful start we made, for

a pall seemed to have settled over Palos at our departure, as almost everyone had a friend or relative in the fleet. The seamen, already gloomy enough, were more so as they saw the tears and heard the bewailings of those who never expected to see them again. When we sailed slowly out of the harbor, my elation was checked by the panic among the sailors as they realized that they were going out on an unknown sea in search of an unknown land. Scarcely had land disappeared when a broken rudder on the *Pinta* was a reminder that somebody had tried that means of getting back to port. But I managed to patch up the damage, so that we could go on to the Canaries, where it took three weeks to get the *Pinta* in shape to proceed. It was on September 6 that we left the Canaries and steered due west.

Now my troubles began in earnest. As we passed Teneriffe, the volcano was belching forth fire and smoke, and this was regarded as an evil portent by the men. Then a calm fell, and they took that as a sign that the Almighty did not favor our expedition. When a strong breeze came and wafted us into the ocean, many of the men wept like children, and begged to be taken back. Indeed, I had to practice one deception, or the crews would have escaped me. I kept a private and a public log book, not putting on the book which the men saw the full number of miles we covered, since that would have added to their alarm and ill temper. Everything was wrong to them. The compass acted strangely, shifting more and more to the west, instead of pointing a little to the east of the pole star. Then we entered vast tracts of seaweed, known later as the Sargossa Sea, wonderful to see but affrighting to the ignorant, who said we should be swamped in it. Next it was rumored that the supplies were running low; and had we not come into a favorable wind the chances are that mutiny would have broken out and I have been murdered. I did all I could by promises and good cheer, and fortunately all became absorbed in the outlook for land, of which there were now many signs. Five weeks of disquiet had passed, when the reward came. The men had demanded a turn-about on October 10, after a false cry of land. I took my stand firmly. We had come so far, I said, that it was useless to turn back; besides, while life allowed I meant to persevere until, by the grace of God, success smiled upon our enterprise.

COLUMBUS RUNS THE SHIPS AGROUND

It was not my speech that saved the day, but some sure signs — a piece of board, a branch of thorn with berries on it, and, above all, a staff carved by some hand. Land must be near. Hope revived. All were eager for the promised reward for the first sight of land.

IN WHICH LAND IS SIGHTED, AND THE BANNERS OF SPAIN AND THE CHRISTIAN CROSS ARE RAISED ON THE WESTERN HEMISPHERE

About ten o'clock on the night of October 11, while standing with a seaman on the stern deck, I saw a light moving in the distance, and we felt sure it was on the land. Before dawn the next morning, low shores could be plainly seen, about six miles ahead. Anchors were ordered dropped, and all the crews waited anxiously for the dawn. My feelings at this time it would be impossible to describe. One thing I realized, that my theory was true.

The Columbus Monument in Genoa, Italy, which claims to be the great discoverer's birthplace, although the year or spot is not definitely known. This is the finest statue erected to him.

COLUMBUS AND HIS VOYAGES: TOP: BUILDING A CARAVEL. COLUMBUS DEPARTING FROM PALOS, SPAIN. BOTTOM: COLUMBUS ON HIS SHIP. THE LANDING ON THE BAHAMA ISLAND OF SAN SALVADOR

SCENES IN THE DAYS OF EXPLORATION

Top: Sir Walter Raleigh. Captain De Noort's men killing sea lions and dogfish. Bottom: Raleigh lands by night, captures Berreo, and ascends the Orinoco 330 miles. Battle of Manila, in the bay where Dewey fought centuries later.

I believed the land was Cipango, and the way to India had been found. As we sailed towards the land in the morning light, the crews joined in chanting the solemn *Te Deum*, and tears were in many eyes. When we had anchored, boats were lowered, and I started for the shore in befitting state, as a representative of Spain. I wore my state robes, and bore the royal standard of Castile. As soon as I stepped ashore, I fell on my knees, kissed the earth, and gave thanks to God for bringing us safely through so many perils. I set up the cross, and took formal possession of the island in the name of Ferdinand and Isabella, naming it San Salvador. The men were loud in praise and protestations of loyalty. Such is the touchstone of success!

The natives fled from us at first, but, as we did not pursue them, they gradually gained confidence and approached us. They were most interesting, of fine figures and attractive faces and rich copper color. Noticing gold rings in their noses I asked, by signs, where the gold came from, and understood their signs to mean lands on the northwest, southwest, and south. Surely, I thought, there lay Cipango and the realms of the Khan of Tartary, with the marvelous wealth so long reported.

Making friends with the natives, who, I felt sure, would easily become good Christians, I decided to take six of them with me, to show in Spain, and also to teach and convert. They might be useful also as guides. Finding that I was on one of a group of islands, I made my way southward, still hoping to find the land of gold. The charm and beauty of these islands surpassed my dreams. The singing of the little birds fascinated me, and the flocks of brilliantly colored paroquets obscured the very sun. When we reached the mainland, as we thought Cuba surely must be, it seemed like heaven itself. But troubles come when we think we are in paradise. First, my treacherous captain, Pinzon, stole away with the *Pinta*. Then the *Santa Maria* struck upon a reef and went over, while I and the crew escaped with difficulty. This left us only the little *Niña*, and she would not carry us all back home; so I had to build a blockhouse on the island of Hispaniola (which I named for Spain), where the native chief was friendly, and leave a little colony behind, when we sailed for home on a January day in 1493.

IN WHICH THE HOME VOYAGE IS MADE AND THE DISCOVERY OF A NEW WORLD IS DECLARED

On our return voyage we got on well for some weeks, and then a storm arose that lasted for three days with unabated fury. The waves broke madly over the little *Niña*, and all gave themselves up for lost. Even I was agonized lest I should perish without making my great discovery known; and taking a piece of parchment I noted down as best I could amid the tossing of the caravel a brief account of our expedition. This I wrapped in a waxed cloth, placed in an empty cask, and threw overboard. Then, while the mountainous seas threatened destruction, I waited and prayed. The crew made vow after vow to perform pilgrimages if ever the vessel came to land. Most mercifully we were spared, as if by miracle. Slowly the storm abated, and we reached the Azores. On we sailed, having to face another terrible hurricane; but now we were nearing home, and under bare poles and in a heavy sea we scudded on until we reached the Tagus.

How the crowds hurried to see our little caravel and to welcome us after our seven months' absence! But of what followed I need not speak; how the journey was made to Seville like a royal procession amid the acclaims of the populace; how I was given place on horseback among the mounted chivalry of Spain, and received with highest honors by the Court; and how the discovery of a new world, as it afterward proved, was hailed with wonder and praise. All that came later of repeated expeditions, successes, and failures, death with plans uncompleted — what matter such trifles when I had been the first to cross the hitherto unsailed Atlantic and practically opened up a new world? For the courtesy with which you have listened, believe me deeply grateful.

The simple dignity with which the story was told, the unaffected modesty of the man, his omission of the unpleasantness that followed his first great achievement, as of that distressing moment in his earlier life when he reached the hospitality of La Rabida with his little son Diego, penniless and hungry — all produced a wonderful effect upon the company, which had listened with almost breathless interest.

Copyright, Hart, N. Y.

THE PINTA AND THE NIÑA, TWO OF THE CARAVELS WHICH FORMED THE LITTLE FLEET OF COLUMBUS ON HIS VOYAGE OF DISCOVERY IN 1492

THE WATCHWORD OF COLUMBUS, THE DAUNTLESS

"ON! SAIL ON!"

[In this stirring poem, Joaquin Miller, our poet of the Sierras, pictures Columbus in the critical hours just before the New World burst upon his eager sight. The sailors had insisted that he turn back, and threatened mutiny.]

Behind him lay the gray Azores,
  Behind the Gates of Hercules;
Before him not the ghost of shores;
  Before him only shoreless seas.
The good mate said: "Now must we pray,
  For lo! the very stars are gone.
Brave Admiral, speak; what shall I say?"
  "Why, say: 'Sail on! sail on! and on!'"

"My men grow mutinous day by day;
  My men grow ghastly, wan and weak."
The stout mate thought of home; a spray
  Of salt wave washed his swarthy cheek.
"What shall I say, brave Admiral, say,
  If we sight naught but seas at dawn?"
"Why, you shall say at break of day:
  'Sail on! sail on! sail on! and on!'"

They sailed and sailed, as winds might blow,
  Until at last the blanched mate said:
"Why, now not even God would know
  Should I and all my men fall dead.
These very winds forget their way,
  For God from these dread seas is gone.
Now speak, brave Admiral, speak and say—"
  He said: "Sail on! sail on! and on!"

They sailed. They sailed. Then spake the mate:
  "This mad sea shows his teeth to-night.
He curls his lip, he lies in wait,
  He lifts his teeth as if to bite!
Brave Admiral, say but one good word:
  What shall we do when hope is gone?"
The words leapt like a leaping sword:
  "Sail on! sail on! sail on! and on!"

Then pale and worn, he paced his deck,
  And peered through darkness. Ah, that night
Of all dark nights! And then a speck—
  A light! A light! At last a light!
It grew, a starlit flag unfurled!
  It grew to be Time's burst of dawn.
He gained a world; he gave that world
  Its grandest lesson: "On! sail on!"

MAGELLAN'S SHIP, THE FIRST THAT SAILED ROUND THE WORLD (OLD PRINT, MADE IN 1602)

THE FIRST TO SAIL ROUND THE WORLD

HOW THE PORTUGUESE MARINER CAME TO FIND HIS FLEET IN SPAIN

INTRODUCED as a son of Portugal who had shed undying luster on his native land, Magellan slowly arose and bowed acknowledgment of the cordial greeting. The dignity of the commanding presence that had enabled him to quell mutinies and overcome enemies was felt by all, and deep silence fell as he spoke.

It seems but yesterday that I was a boy playing on the quays of Oporto, often looking out upon the blue waters and dreaming of voyages and adventures, for my head was full of the sea and of unknown islands. The air was full of wild tales, since the sailings of the great Columbus had stirred many to follow in his wake and get fame and riches for themselves. I liked much these stories, and was fond of drawing maps, and became expert in these matters for my age. When I told my father I was decided to become a sailor like Columbus, he sent me to the king, who put me in the way of an education. I made mathematics and navigation my special study, and without immodesty I may say that few knew more than I of the voyages and discoveries that had been made. I was sure I could find a new way to those islands of indescribable riches; and find it by sailing *west*, instead of east. That was my own idea, and I lived upon it.

But much was to happen before I could test it. For seven years I led a life of siege and shipwreck, war and wandering, at length receiving in Africa the wound in my knee which ever after made me lame. This decided me to lay before King Manuel my plan for an expedition that should bring Portugal fame and riches. But he received me coldly, laughed at me for a dreamer, and even insinuated that I was only shamming a wound to escape further service. Angry at the insult and disappointed in plans, I resolved to leave Portugal forever, renounce my country, and seek service with Spain, as Columbus had been driven to do before me.

Charles V was as quick to see the advantages of my scheme as my own sovereign was blind to them. He was most kind, agreeing I should have a fleet, and one fifth of all the cargoes of spices shipped to Spain from the islands I might discover; while as for the islands themselves, he was to choose six for himself, leaving the seventh and eighth to me. What more could I ask? Of course I was to meet with troubles. Rivals tried to circumvent and even assassinate me, but at last a final official paper, dated Barcelona, July 26, 1519 — the great date to me — placed me in sole command of the expedition which, if my plans succeeded, was to sail round the world for the first time, although I did not dare to say so aloud.

I had five caravels: the *Trinidad*, of 120 tons burden, my own flagship; *San Antonio*, 120 tons; *Concepcion*, 90 tons; *Victoria*, 85 tons, and *Santiago*, 75 tons. Of the vessels, one wrote to the King of Portugal, "They are very old and patched, and I would be sorry to sail even for the Canaries in them, for their ribs are soft as butter." But I would have sailed in a tub, so anxious was I to prove my theory. Indeed, old ships were not my worst trouble. In Juan de Cartagena, my second officer in command, I had a Spaniard of the most jealous and insolent disposition, who could not forgive me for being placed in charge, and I was compelled to put him in irons before we had been a week at sea, and later to put down a conspiracy and mutiny in which he had a principal part. The men, a motley crew of

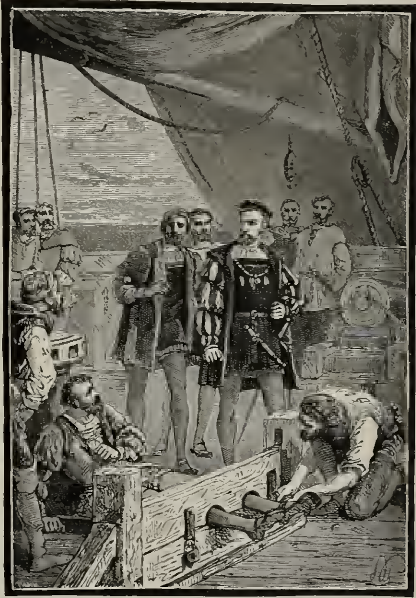
some 280, comprised Spaniards, Portuguese, Genoese, French, Germans, Greeks, Malays, and one Englishman. They had little love for the undertaking and no loyalty, and I found it no light task to be commander. I need only say that it was necessary to be firm, and that I was bound to let nothing prevent me from going on. Hence, when the captains of three of my ships conspired to murder me and led their men into mutiny, I was fortunate enough to find out their plans, and to forestall them with some of my own, which of necessity included the execution of two of the conspirators in short order, and the putting of others in irons. When the crews saw that mutiny was not regarded lightly, they afterwards found it convenient to obey orders, though not always cheerfully.

HOW A VISION CHEERED THE CREWS AND A RACE OF GIANTS APPEARED

I cannot blame the men, for they had all the hardships, and lacked my enthusiasm and outlook. Then we had plenty of bad weather. "The upper air burst into life," and a month of heavy gales tested us severely and caused much suffering. Indeed, I do not know how we should have gotten the men to hold out, but for a vision of St. Anselm which appeared to them in the form of a fire lighted at the summit of the mainmast and remained there near two hours and a half, which comforted them greatly and gave them hope. No wonder that after two months of rain and storm the spirit of mutiny should show itself. But when my faithful officers told me of it, I said, "Be they false men or true, I will fear them not; I will do my appointed work!" That made deep impression upon the men, who knew how I kept my word.

It was in November that we made the coast of Brazil in South America. We could now procure food, and the crews were more contented. The natives traded with us on easy terms. For a knife they produced four or five fowls; for a comb, fish for ten men; for a little bell, a basketful of sweet potatoes.

The day after Christmas we were sailing along the coast southward, and early in the new year anchored at the mouth of the River Plate, where we heard stories of the cannibals who had eaten an explorer some years before. We gave them as wide berth as possible, and sailed through February and March along the shores of Patagonia, as bleak a coast as one could see. This was unpleasant enough, with winter coming on and no straits found. The storms burst over our little ships, accompanied



MAGELLAN PUTS JOHN OF CARTAGENA IN THE STOCKS, FOR MUTINY

by terrific thunder and startling lightning, such as we never saw before. The poops and forecastles were carried away, and we all expected destruction, when that vision of St. Anselm appeared, and the storm ceased. We now had to get a safe winter harbor, and found it in Port St. Julian, as I named the place. This was the hardest winter of my life. I knew we must stay there four or five months, and had to put the men on short rations, for fear the food should run short. This caused a demand for an immediate return to Spain, and mutiny

was rife. But by promptness I struck such terror to the hearts of the mutineers that no man ever tried to mutiny again under my command. I gave the chief mutineers no chance to try it again.

We were in port two whole months without seeing a single native. Then, one day, without anyone expecting it, we saw a giant on the shore, dancing and leaping and singing. He was so tall that the tallest of us only came up to his waist, as it seemed. He was well built, had a large face painted red all round, and his eyes were painted yellow round them, and two hearts were painted on his cheeks. He had but little hair on his head, and it was made stiff and white with whitewash. He pointed to the sky, to know whether we had come down from it. He was soon joined by others, who seemed surprised to see such large ships and such little men. They were most astonished at the sight of a mirror, looking into which produced great consternation among them and some fear. They were wrapped in enormous fur cloaks, and wore large leather boots, so that they were nicknamed Large-feet. For arms they had a short, massive bow, and reed arrows, with a point formed of sharp pebble, a dangerous weapon.

It is good to pass quickly over the hardships of that winter season in South America. With the return of warmer weather we set sail again, but only to run into a great storm which wrecked the little *Santiago;* but happily we were able to save the men and provisions. After a few days we found the straits for which I had been looking so long. That was the happiest day of my life. I was not thinking of glory, but I am glad that men have called the straits after me ever since.

HOW THE PACIFIC WAS DISCOVERED AND CROSSED WITH UNTOLD HARDSHIPS

Our struggles seemed only begun, however. For more than five weeks we made our way through the winding channels of the unknown straits. The men were threatening, the weather was bad, snow-covered mountains rose on one side. One of the four remaining ships stole silently away, leaving us with three only. The men begged piteously to be taken home, fearing starvation. I said quietly, "If I have to eat

the leather of the ships' yards, yet will I go on and do my work." They knew that I meant it, and on we went. Constant fires were seen on the southern side of the strait, and I called that land Tierra del Fuego (land of fire). We were glad enough to leave it, and get, as we did at last, into the open sea once more. I confess that when I saw a clear way to the other sea, tears fell for very joy. My theory was true. There was another main sea, and I had found it; I had been the first to sail from the Atlantic into it. Now we came into still waters, in such contrast after the heavy, tiring storms that I naturally called the new sea the Pacific, and so it has been called, and will be, I suppose, till there shall be no more sea.

HOW THE FAMISHED SAILORS ATE HIDES, SAWDUST, AND RATS, TO KEEP FROM STARVATION

Our three little ships, battered and worn, manned by crews gaunt and shivering, now put northward as fast as possible, to get out of the cold before turning to cross the strange new ocean, which we thought only a narrow stretch of waters between the coast and the Spice Islands. It was well we did not then know how wide the Pacific was. For two months we sailed on, week after week, before we sighted land. Then it proved to be only a small wooded island, without a living being upon it, and I named it St. Paul's Island. Presently another island was passed, without people, nothing to be seen but sharks. They wanted food, and so did we. In truth, we had little left. We ate biscuit, but it was biscuit no longer, but a powder full of worms. My words came only too true. We had to eat the hides on the mainyard, first exposing them to the sun to soften them, putting them overboard for three or four days, and then cooking them on the embers and thus eating them. We had also to eat sawdust, and rats were a great delicacy. Scurvy broke out, and nineteen poor fellows died and thirteen lay too ill to work. The one consolation I have is that I endured every hardship the men did, and they knew I had my full share of all the suffering. That held them to me for the time to come. For ninety-eight days we sailed across that sea, so vast the human mind can scarcely grasp it; more than three months of awful trial; and then we came to a little group of islands on which lived savages of the lowest type, the greatest thieves I ever saw, and I had seen many; so that I named their islands the Ladrones (robbers). We got fresh food, however, and that put new life into us — all of us but our one Englishman, Master Andrew of Bristol, who had been one of my best men. He died just as succor came.

HOW THE END CAME TO A NOBLEMAN WHO KNEW NO FEAR

Soon afterwards we sighted another group of islands, which I named the St. Lazarus Islands (now the Philippines). Here I met some merchants from China, and they assured me that the famous Spice Islands were not far away. Thus I had practically accomplished my purpose. I had sailed round from one ocean into the other, had proved that there was a westward passage, and had but to load my ships and sail on to Spain by the known route. But the providence that had led me through so many misfortunes and trials had decreed that I should not return to my home. Perhaps it was my own fault. I thought it best to cruise among the islands, to make friends of the natives and convert them if possible to our faith, and to procure gold if it could be found. I set a cross and a crown of thorns on the top of the highest mountain that all might see it and worship. Having no fear of the Indians, I did not expect trouble; but one of the native kings was insolent and I had to teach him the majesty of Spain. I remember well it was on a Friday morning that I sent three long boats, with sixty men in cuirasses and helmets and armed with muskets, to subdue the rebels. I led them in the attack, but we were at a disadvantage because we had to leap from the boats and wade between the rocks in the shallows; and here the thousands of natives assaulted us with stones, arrows, javelins, and spears. My men fought with the courage of desperation, but were so outnumbered that it was in vain. I think we would have made good our retreat, but when we were moving backward through the shallow water, fighting every step, a group of the savages rushed upon me, disabled my arm so that I could not wield my sword, gave

me a cut in the leg that threw me down, and as I fell I knew my earthly course was run.

THE DEATH OF MAGELLAN AS HE WAS RETREATING TO HIS BOATS

Death was painless, and without regret. The dream of my life had been realized. What could one wish more than to be known through the generations of mankind as the geographer who added an ocean and new continents to the map, and who first sailed round the world? Surely I have cause to be happy and glad in my presence here to-day, and in your kind recognition. My story is told.

IN WHICH THE HISTORIAN ADDS A FEW FACTS AND SOME WORDS OF DESERVED PRAISE

Such was the tragic fate of Magellan, described by Pigafetta, the historian of the expedition, as "our mirror, our light, our comforter, our true guide." After dauntless resolution he died in a miserable skirmish when on the very eve of victory. With grief the remaining members of the crew, now 115 in number, crowded on to the *Trinidad* and *Victoria* for the homeward voyage. In September, 1522, they reached the Spice Islands, took on board some precious cloves and birds of paradise, and laden with spices resumed their journey. But the *Trinidad* was too overladen and too rotten for so long a voyage till she had undergone repairs; so the little *Victoria* alone sailed for Spain with sixty men aboard to carry home their great and wonderful news. Perhaps it was well that Magellan did not live to witness the sufferings of that homeward voyage, on which, through starvation and untold miseries, man after man drooped and died, till by the time they reached the shores of Spain only eighteen gaunt survivors were left to tell their proud story of the first circumnavigation of the world by their lost commander, Ferdinand Magellan.

THE STORY OF LEIF THE VIKING

HOW AN INTERRUPTION WAS PERMITTED AND THE NORTHMEN'S CLAIM TO THE DISCOVERY OF AMERICA WAS ENTERED

THE narrative of the fourth night was by the Italian, Amerigo Vespucci, whose name was given to the New World, as many think, unjustly, and who defended himself well against many charges that had been laid. His story was full of interest, and may be read in the records, as there is not room for it here. When it was done, suddenly a tall and very strikingly handsome man, who was sitting near the end of the table, arose and asked the privilege of entering a counter-claim to the discovery of the new world known as America. He did not wish to dispute the merits of the great discoverers Columbus and Vespucci, but in the interests of truth and justice to a brave race he deemed it fair that his story should be heard at this time.

There was something so engaging in the manner of Leif the Norseman, who towered high above most men in the company, that the

A FLEET OF VIKING SHIPS

Judge put the question whether the club would at once hear from the son of Erik the Red, and a unanimous cheer gave him the floor. Not long he spoke, and this is his tale.

HOW LEIF DISCOVERED VINLAND IN THE YEAR ONE THOUSAND, NEARLY FIVE HUNDRED YEARS BEFORE COLUMBUS SAILED

I would not seem immodest, sir, in such a company, but I speak for my people, who have had scant recognition for their early daring on the seas. By rights my father should tell this story, for he landed on the continent called America in 978, a hundred years after Gunniborn the Norwegian had come back from an unknown country far west of Iceland, having been driven out of his course by a violent wind. My father spent three years sailing along the coasts of Greenland, as he named the country, looking for a home. He made one in a little oasis in the midst of bleak surroundings, and founded a colony there in the polar regions. By mere chance, while on a voyage to Greenland, one of my father's men, named Bjarni, sailed in a dense fog far out of his way, and when the fog lifted found himself on a well-wooded coast free from the ice-covered crags of Greenland. He did not land, but turned his vessel northward; and on his reaching home I heard about what he had seen. Then I resolved to find out if there was such a land. Learning from Bjarni himself of his adventures, I bought a ship and collected a crew of thirty-five sailors, setting sail from Brattahlid, the Greenland colony, in the fall of the year 1000. That is the year in which America was first set foot upon, as I claim, by a white man.

It was not long before our ship reached a sterile country, covered with big stones, which we named Helluland (probably Labrador). I went ashore, but, finding nothing of value, followed along the coast until we came to a more promising country, when again I cast

anchor. We were too eager to get ashore to wait for high tide, and ran out on the beach where a river flowed from a lake. Towing our ship into this lake when the tide rose, we cast anchor, took our leather bags ashore, and there built booths. We resolved to stay over the winter, as there was plenty of salmon in the river, and one of my men soon discovered wild grapes in plenty. We built log huts, felled trees to fill the ship, gathered grapes, fished, and had a good winter, with much longer days than in Greenland or Iceland, and much milder weather. When spring came, we had a shipload of fine timber, and sailed for home. I named the land Vinland. That it was on the coast of America, somewhere between the Cape Cod and Cape Ann of the present maps, there is no doubt. After I reached home in Greenland in 1001, my brother Thorvald took my ship and went after more timber, easily finding my huts, but losing his life in a fight with hostile Indians, who put out from a creek in their birch-bark canoes and attacked his ship. Another brother went to bring back Thorvald's body, but was blown to sea and did not get a sight of Vinland. Others tried later to establish colonies, but without success, and I admit that we Norsemen did not make a permanent settlement on the new continent. But I claim that we did discover it, and that I was the first to land upon it, although I have no desire that it should be called Leifland. All I ask for is simple justice.

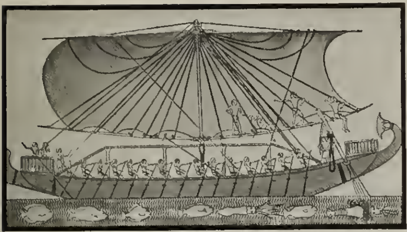
He sat down amid applause. All agreed as to the interest of this narrative, and the sincerity of the narrator; nor did any doubt that he had actually been in America as he said. His discovery could not detract from the just fame of Columbus or any other explorer; but it belongs to the credit of the brave sea rovers who were real explorers, while too many of them were also pirates and freebooters — as some of them would doubtless glory to declare, Eric the Red himself belonging to that dauntless class which feared neither Thor nor man.

THE END OF THE CLUB STORIES

Thus I have given some idea of the rich feast that lasted for thirty royal nights — such a month of personal narration of great deeds as no planet had ever known before. Those of us who were present will never forget the delight of our Great Nights with the Explorers and Discoverers. And some day perhaps I may tell the story of my own adventures in the air.

STATUE OF LEIF ON COMMONWEALTH AVENUE, BOSTON

THE VIKINGS SAILING THROUGH THE DRIFTING MIST



EGYPTIAN SHIP OF THE EXPEDITION TO PUNT, ABOUT 1600 B.C. (FROM A ROCK CARVING)

HOW WAS THE WORLD DISCOVERED?

BEFORE history began, mankind started off in three or four family groups and tramped in every direction for some thousands of years, so that there were tribes or races of men of various colors and customs in all parts of the world. But evidently these peoples only knew about their section and themselves, and did not know that there was any other part of the world or any other people. It was only as adventurous men in one land or another became explorers and discoverers that the fact of several continents and many races became known.

Let us say, then, that when the start was made in the long valley between the Tigris and Euphrates rivers in Asia, where tradition locates the "Garden of Eden" and "the cradle of the human race," there were peoples already in Europe and Africa, in China, and in North and South America. They had lost all track of one another, as the seas had come to separate the continents. The red peoples who had roamed far off to the American continents did not think of leaving their shores. The yellow peoples were shut off by the mountains and seas, and had no desire to go anywhere else. The Europeans were savages, occupied with hunting and fishing, but not until much later developing the exploring spirit. The black peoples of Africa were of a still lower type of savages, and never invented anything or seemed to care what was beyond their seacoasts and sand deserts.

For the inquisitive men, the kind who want to know everything and do strange and daring things, we must look to the Aryan peoples who began their civilization in Arabia and Persia and kept pushing out. Not that the masses of the people of any land at any time ever had the pioneer spirit; but here and there a leader would arise and inspire a group of followers to seek out new places until the end of the world was reached. Discoverers and explorers, like poets and great generals, are born with the genius for their special work within them.

How did the people who lived around the Mediterranean Sea come to know the other parts and peoples of the globe? By exploration and discovery, of course. But what led the explorers to risk their lives in hazardous adventures? Several motives: inborn curiosity, love of conquest, desire to trade or get gold, and, in a few cases, purely scientific quest of knowledge. Commerce and sailing began at the eastern end of the Mediterranean, and we shall see how exploration began.

THE DARING PHŒNICIANS

In Syria, the highway between Babylonia and Egypt, dwelt a tribe of dusky people known as Phœnicians. Living on the Mediterranean shore, they soon became skillful sailors. They built ships and ventured forth on the deep; they made their way to the islands of Cyprus and Crete, and thence to Greece, bringing back goods from other countries to barter with their less daring neighbors. They cruised along the northern coast of the Great Sea to Italy, along the coast of Spain to the Rock of Gibraltar, and out into the open Atlantic through the Pillars of Hercules. How their little sailing boats lived through the ocean storms we do not know, for the records are lost, but they undoubtedly reached the northern coast of France and brought back tin from the Tin Islands (the British Isles). In their home markets were found all manner of strange things from foreign unknown lands, discovered by these master mariners, who deserve the name of the earliest explorers.

SOME EARLY EXPLORERS

Among the early explorers, whose names can only be mentioned here, are Hanno the Cartha-

From Homer to 1510, after the discoveries of Columbus.

THE UNROLLING OF THE CLOUDS — V.

[illegible] after its circumnavigation by Sir Lrancis Drake in the year [illegible]

[illegible]HE UNROLLING OF THE Cl[illegible]

The world as known after the voyages of Captain C[illegible] [illegible]

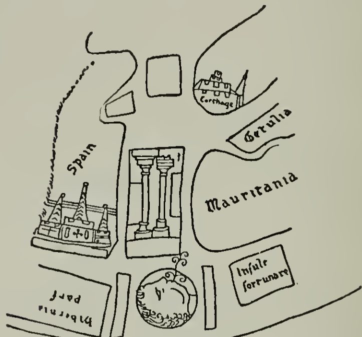
The world as it was known up to 1776, wben our national life began.

ginian (520 B. C.), Nearchus the Cretan (326 B. C.), Benjamin of Tudela 1160 A. D.), and Ibn Batuta the Moor (1325 A. D.). Some great travelers and conquerors might well be named also, for they did not a little to extend knowledge of the world. There was Herodotus (484 B. C.), the Greek historian, one of the greatest of ancient travelers. Alexander the Great (333 B. C.) sent out explorers, and Cæsar, also a world conqueror, led his legions as far as Britain (58 B. C.), where their monuments are still to be seen. Then there were early geographers like Strabo of Cappadocia (50 B. C.), who wrote a geography in seventeen books, in large part preserved. He believed the world was one vast island, 3000 miles broad by 7000 long. Next came Ptolemy of Alexandria (150 A. D.), who summed up all that was known about land and peoples, and made a map that is a wonder. While he made mistakes, we should be glad of it, because one of his mistakes encouraged Columbus to start on the voyage that discovered America. There was no discovery of great importance, however, until the period we are now coming to. The people in general, up to this time, believed in a flat earth surrounded by water, although a few daring spirits had come to a different conclusion, and knew that the earth was round. But no one had yet gone around it, and it was not even safe to proclaim one's belief in such a wild theory. Those were rightly known as the Dark Ages.

THE NEW AND GREATEST ERA OF DISCOVERY

Now we open one of the most wonderful chapters in the great book of discovery. The man who started this new era was Prince Henry (1394–1460), son of the great King John of Portugal. At the age of twenty the Prince had learned something of inland Africa and the distant coast of Guinea, and was fired with ambition to explore along the west coast of Africa and possibly reach India by sea. The ocean was then a formidable foe, unconquered and unexplored, on which ships dared not venture out of sight of land, since they did not know where the winds would carry them, nor if they could ever get back if once they were lost in the fog. In Sagres, at the southern end of Portugal, Prince Henry took up the study of astronomy and mathematics, gathered around him men of science, built ships, and trained Portuguese sailors in the practical arts of navigation.

Then he started expeditions which were to make Portugal famous. In 1418 two gentlemen of his household, Zarco and Vaz, volunteered to sail for Cape Bojador in Africa, and through being driven out to sea by storm discovered an island which they named Porto Santo, as they found it a port of safety. They



THE PILLARS OF HERCULES, AS AN ANCIENT GEOGRAPHER SAW THEM

hastened back to tell the news, and asked leave to establish a Portuguese settlement there. Prince Henry gave them ships and all they needed, but added a rabbit and her family to the outfit; and in two years the rabbits on the island had destroyed all its vegetation. But Porto Santo was a Portuguese colony, and Perestrello was made its governor — a fact we note simply because his daughter became Mrs. Christopher Columbus, though she spelled it Cristovao Colon.

The island of Madeira was next discovered and settled, and the first two Portuguese children born there were named Adam and Eve. Prince Henry kept sending out his little ships, urging his captains to sail not only to Cape Bojador but beyond it. It seems that the mariners had been terrified by the dangerous surf breaking on the shore; and stories were told

THE NATIVES FOUND BY COLUMBUS, AND THE COLONY OF ISABELLA

that any man who passed the cape would be changed from white into black, and that there were sea monsters, sheets of burning flame, and boiling waters beyond. This was disproved by the young knight Tristan, who discovered the white headland beyond Cape Bojador, naming it Cape Blanco (white), and then coasted along to the south as far as Sierra Leone, where Hanno was many centuries before. Here he received some gold dust, and took this and some negroes to Lisbon, where the strange black people caused the most lively astonishment, while the gold awakened the spirit of adventure. Now there were volunteers enough.

Italians flocked to Portugal, anxious to take service under Prince Henry.

He cared little for the gold. His desire was to find a way to India, and to teach the heathen to be Christians. He always welcomed men with superior knowledge of navigation. He did much to extend knowledge of Africa.

In 1460 he fell ill, and shortly afterward died. He had earned the title of "originator of modern discovery." He had furnished the money and outfits which made it possible for the Portuguese navigators to sail for two thousand miles down the West African coast. But for his enthusiasm and devotion to his ideals it is doubtful whether America would have been added to the map in 1492. The spirit of exploration which he had stimulated did not pass away with him. But if he had lived, it is more than probable that Columbus would have sailed in the service of Portugal instead of under the flag of Spain.

ADDING CONTINENTS TO THE WORLD MAP

Now came the chief era of discovery, which added new continents and oceans to the map. What Columbus did we have heard in part from his own lips. Much of his story is sad, as his colonies were ill fated, and his second, third, and fourth voyages were filled with trials which broke his health and spirit. Once he was sent to Spain in chains as a felon, often he had to struggle with envious foes, and finally in 1504 he reached Spain, to be carried ashore on a litter, and to learn that the Queen of Spain, his steadfast friend, was dead. Friendless, penniless, sick, "after twenty years of toil and peril," he says piteously, "I do not own a roof in Spain." He had made America known, had discovered the great continent of South America, but did not know it, and passed away in 1506 unconscious of the great New World he had reached. That New World bears another name than his, yet —

"When shall the world forget
The glory and the debt,
Indomitable soul,
Immortal Genoese?
Not while the shrewd salt gale
Whines amid shroud and sail,
Above the rhythmic roll
And thunder of the seas."

WHENCE CAME THE NAME AMERICA?

Columbus discovered land on this side of the Atlantic on October 12, 1492. That day brought the New World into the realm of European knowledge. Seven years later a Florentine pilot, Amerigo Vespucci (Amer′igo Ves-poo′-che), sailing in the expedition fitted out by a young Spaniard, Hojeda (O-hay′-da), who had been with Columbus on his second voyage, reached the mainland of South America and found a native village with houses built on tree trunks and connected by bridges. This was so like a bit of old Venice that it was called Little Venice, or Venezuela, which name it still bears.

A NEW WORLD

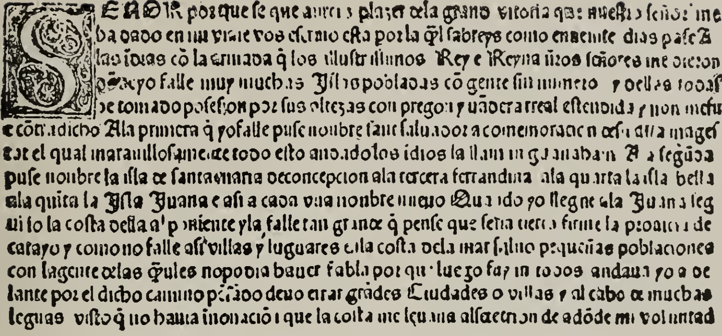
Nothing was publicly known of this voyage till a year after the death of Columbus, when men had coasted farther to the south of Venezuela and discovered that this land was neither Asia nor Africa but a new continent indeed.

"It is proper to call it a New World," says Vespucci. "Men of old said over and over again that there was no land south of the equator. But this last voyage of mine has proved them wrong, since in southern regions I have found a country more thickly inhabited by people and animals than our Europe or Asia or Africa."

An account of Vespucci's voyages, published in Paris in 1507, made a deep impression, and since Columbus had said nothing about discovering a new continent (and indeed he did not suppose or know that he had), men declared that Amerigo Vespucci had discovered a new continent, "wherefore it ought to be called America from its discoverer Amerigo, a man of rare ability, inasmuch as Europe and Asia derived their names from women."

Surely it was fair that man should have his turn. And that is how our continent came to be called America, instead of Columbia. Columbus has the glory, and Vespucci has the name.

It has been the common view that Vespucci was not fair to Columbus in claiming the discovery of a new world. This is not correct; nor is it true to say that Vespucci gave his own name to the new continent he found. The name was proposed by a German geographer, who was deeply impressed by the story which Vespucci told. The Latin name, Americus Vespucius, is commonly used.


SEÑOR porque se que aureis plazer dela grand vitoria que nuestro señor me
ha dado en mi viaie vos escriuo esta por la ql sabreys como en xxxiii dias pase A
las indias cō la armada q los illustrissimos Rey e Reyna nros señores me dieron
donde yo falle muy muchas Islas pobladas cō gente sin numero y dellas todas
he tomado posesion por sus altezas con pregon y vandera real estendida y non me fu
e cōtradicho A la primera q yo falle puse nombre sant saluador a comemoracion de su alta magest
at el qual marauillosamente todo esto a dado los indios la llaman guanahani A la segūda
puse nombre la isla de santa maria de concepcion ala tercera ferrandina ala quarta la isla bella
ala quinta la Isla Juana e asi a cada vna nombre nueuo Quando yo llegue ala Juana seg
ui io la costa della al poniente y la falle tan grande q pense que seria tierra firme la prouincia de
catayo y como no falle asi villas y luguares ela costa dela mar saluo pequeñas poblaciones
con la gente delas quales no podia hauer fabla por que luego fuyan todos andaua yo a de
lante por el dicho camino pēsando deuo errar grādes Ciudades o villas y al cabo de muchas
leguas visto q no hauia innouaciō i que la costa me leuaua al setentrion de adōde mi voluntad

FACSIMILE OF COLUMBUS' LETTER TELLING OF HIS DISCOVERY

FROM COLUMBUS' OWN LETTER

A few extracts from the letters which Columbus and Vespucci wrote home, translations from the Spanish, will give a more personal feeling of the experiences of the great explorers. This is the way Columbus begins his letter to his friend, who would deliver it to the Queen and others concerned:

"Sir, As I know that you will have pleasure of the great victory which our Lord hath given me in my voyage, I write you this, by which you shall know that in twenty days I passed over to the Indies with the fleet which the most illustrious King and Queen, our Lords, gave me: where I found very many islands peopled with inhabitants beyond number and, of them all, I have taken possession for their Highnesses, with proclamation and the royal standard displayed; and I was not gainsaid."

He goes on to tell of the trip which he made, and then of these islands. "The lands thereof are high, and in them are very many ranges of hills, and most lofty mountains; and all most beautiful in a thousand shapes, and all accessible, and full of trees of a thousand kinds, so lofty that they seem to reach the sky. And I am assured that they never lose their foliage; as may be imagined, since I saw them as green and as beautiful as they are in Spain during May. And some of them were in flower, some in fruit. And the nightingale was singing and other birds of a thousand sorts in the month of November.

"The people have no iron or steel or any weapons; nor are they fit thereunto; not because they are not a well-formed people and of fair stature, but that they are most wondrously timorous. They have no other weapons than the stems or reeds, on the end of which they fix little sharpened stakes. Even these, they dare not use; . . . but as soon as they saw us approach they fled. And this was not because any hurt had ever been done to any of them. On the contrary, at every headland where I have gone and been able to hold speech with

KING SENDING OUT AN EXPEDITION
(From the original print in the Spanish Edition)

them, I gave them of everything which I had, as well cloth as many other things, without accepting aught therefor. It is true that since they have become more assured, and are losing that terror, they are artless and generous with what they have, to such a degree as no one would believe but him who had seen it. Of everything they have, if it be asked for, they never say no. . . . And whether it be a thing of value or one of little worth, they are straightways content with whatsoever trifle of whatsoever kind may be given in return for it. I forbade that anything so worthless as fragments of broken platters, and pieces of broken glass, and strap-buckles, should be given them; although when they were able to get such things, they seemed to think they had the best jewel in the world, for it was the hap of a sailor to get, in exchange for a strap, gold to the weight of two and a half castellanos, and others much more for other things of far less value.

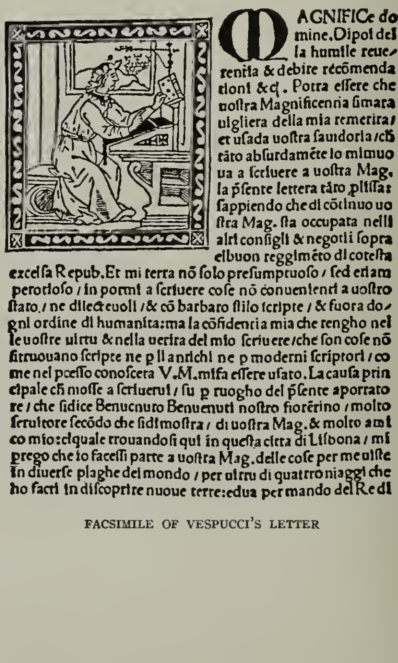
"To this day I carry those with me who are still of the opinion that I come from heaven. . . . And they were the first to proclaim it wherever I arrived; and the others went running from house to house and to the neighboring villages, with loud cries of 'Come, come to see the people from heaven!'"

FROM THE LETTER OF AMERIGO VESPUCCI TO PIER SODERINI, GONFALONIER OF THE REPUBLIC OF FLORENCE

"Magnificent Lord: After humble reverence and due commendations, etc. It may be that your Magnificence will be surprised by my rashness and the affront to your wisdom, in that I should so absurdly bestir myself to write to your Magnificence the present so-prolix letter: knowing as I do that your Magnificence is continually employed in high councils and affairs concerning the good government of this sublime Republic. And will hold me not only presumptuous, but also idly-meddlesome in setting myself to write things, neither suitable to your station nor entertaining, and written in barbarous style, and outside of every canon of literature."

After a page or more of this kind of elaborate explanation and apology, which was evidently the proper form when a person of his station addressed so grand a lord, Vespucci tells how he came to go on this voyage of exploration "in which we were eighteen months engaged, and discovered much continental land and innumerable islands, and great part of them inhabited."

"Thirty-seven days beyond the Canary Islands, we anchored with our ships a league and a half from land: and we put out our boats freighted with men and arms. We made towards the land, and before we had reached it, had sight of a great number of people who were going along the shore: by which we were much rejoiced; and we observed that they were a naked race. They showed themselves to stand in fear of us: I believe because they saw us clothed and of other appearance than their own. They all withdrew to a hill, and for whatsoever signals we made to them of peace and of friendliness, they would not come to parley with us: so that now as the night was now coming on, and as the ships were anchored in a dangerous place, being on a rough and shelterless coast, we decided to remove from there the next day, and to go in search of some harbor or bay, where we might place our ships in safety.



MAGNIFICe domine. Dipoi della humile reuerentia & debire recōmendationi &c. Potra essere che uostra Magnificentia simara uigliera della mia temerita et usada uostra saudoria / cō tāto absurdamēte lo mimuoua a scriuere a uostra Mag. la pſente lettera tāto plissa: sappiendo che di cōtinuo uostra Mag. sta occupata nelli alti consigli & negotii sopra el buon reggimēto di cotesta excelsa Repub. Et mi terra nō solo presumptuoso / sed etiam perotioso / in pormi a scriuere cose nō conuenienti a uostro stato / ne dilecteuoli / & cō barbaro stilo scripte / & fuora dogni ordine di humanita: ma la cōfidentia mia che tengho nelle uostre uirtu & nella uerita del mio scriuere / che son cose nō si truouano scripte ne p li antichi ne p moderni scriptori / come nel pcesso conoscera V. M. mi fa essere usato. La causa principale chi mosse a scriuerui / fu p ruogho del pſente aportatore / che si dice Benuenuto Benuenuti nostro fiorētino / molto seruitore secōdo che si dimostra / di uostra Mag. & molto amico mio: el quale trouandosi qui in questa citta di Lisbona / mi prego che io facessi parte a uostra Mag. delle cose per me uiste in diuerse plaghe del mondo / per uirtu di quattro uiaggi che ho facti in discoprire nuoue terre: e dua per mando del Re di

FACSIMILE OF VESPUCCI'S LETTER

And we sailed with the northwest wind, thus running along the coast with the land ever in sight, continually in our course observing people along the shore: till after having navigated for two days, we found a place sufficiently secure for the ships. This same day we put to land with the boats, and sprang on shore full forty men in good trim. And still the lands-people appeared shy of converse with us, and we were unable to encourage them so much as to come to speak with us. And this day we labored so greatly in giving them of our wares, such as rattles and mirrors, beads, balls, and other trifles, that some of them took confidence and came to discourse with us. And after having made good friends with them, the night coming on, we took our leave of them and returned to the ships. The next day when the dawn appeared we saw that there were infinite numbers of people upon the beach, and they had their women and children with them. We went ashore and found that they were all laden with their worldly goods. And before we reached the land, many of them jumped into the sea and came swimming to receive us at a bowshot's length from the shore, for they are very great swimmers, with as much confidence as if they had for a long time been acquainted with us And we were pleased with their confidence.

"... The manner of their living is very barbarous, for they eat at no certain hours, and as oftentimes as they will: and it does not matter much to them that the will may come rather at midnight than by day, for they eat at all hours. And their repast is upon the ground without any tablecloth or any other cover, for they have their meats either in earthen basins which they make therefor, or in the halves of pumpkins; they sleep in certain very large nettings made of cotton, suspended in the air: and although this their fashion of sleeping may seem uncomfortable, I say that it is sweet to sleep in those nettings: and we slept better in them than in quilts."

VESPUCCI'S DISCOVERY OF AMERICA

Amerigo Vespucci landing on the South American shore and finding a native in a hammock.

VASCO DA GAMA AND INDIA

While the western world was being discovered and Italians were giving to Spain a possession and glory that might have been Portugal's, a Portuguese explorer, named Vasco da Gama, found the sea route to India by the East.

VASCO DA GAMA

Only a few years after the discovery of America, he proved that India could be reached by the Cape of Good Hope, and the dream of Prince Henry was fulfilled.

It was in July, 1497, that the four little ships, "low amidships, with high castles towering fore and aft," which rode the water like ducks, started on the longest voyage on record and one of the most important. Steering southwest, they sailed for ninety-six days out of sight of land, making some four thousand five hundred miles, then drifted on to the southwest coast of Africa. Even Columbus had been only two thousand six hundred miles without seeing land. After a skirmish with some tawny-colored Hottentots the explorers sailed on, "putting their trust in the Lord to double the Cape." But the storms raged, the waves rolled high, the days were short and the nights long, and the crews grew sick with fear and clamored to put back home. The commander saw how much reason they had to despair, for the ships were now leaking badly, and cold rains soaked them all to the skin; but he bade them be silent, and vowed he had promised God not to turn back a single span's breadth of the way, and would throw into the sea whosoever spoke such things. His iron will conquered, and at last the storms ceased, the seas grew calm, and they knew that they had doubled the dreaded Cape, "on which great joy fell upon them and they gave great praise to the Lord."

Onward they sailed, where no European had

DEPARTING FROM A SPANISH PORT

sailed before, and on Christmas day found land which they christened Natal, in commemoration of Christ's Nativity; and Natal is one of the best-known parts of South Africa to-day.

Arrived at Mozambique, a low-lying coral island, they found four ocean-going ships belonging to Arab traders, laden with gold, silver, cloves, pepper, ginger, rubies, and pearls from the East. But at Mombasa they were nearly killed by treacherous Mohammedans, who hated the "dogs of Christians." Escaping, they crossed the Arabian Gulf in twenty-three days, and on May 21, eleven months after the start, they saw the shores of India, famed land of wealth. They found welcome in the city of Calicut, which was inhabited by Christians of tawny complexion, with big beards and long hair, also mustaches, according to the diary. Within the town the merchants lived in large wooden houses thatched with palm leaves.

Vasco da Gama did not get gold and spices, but he had discovered the ocean route to India, and on his return home after his two years' absence he was received with highest honors by King Manuel, and given a pension of three thousand ducats yearly. As compared with Columbus his reward was indeed great.

BALBOA SEES THE PACIFIC

One of the most stirring stories of discovery is that of Vasco Nuñez de Balboa, the first white man to see the Pacific Ocean (1513). Of good family and education, this Spanish gentleman emigrated to Hayti, got into debt, and then got out of the island by hiding himself in a bread-cask on board a ship bound for Darien. The angry captain finally relented, and soon afterward owed his life to the stowaway, for the ship struck a rock, and Balboa, brave and intelligent, led the shipwrecked crew to a river of which he knew, called Darien by the Indians. He did not know that they stood upon the Isthmus of Panama, the narrow neck of land only sixty miles across, that connects North and South America and separates the two oceans, brought together in our day by the Panama

LA MINA (FROM AN OLD PRINT). VASCO DA GAMA AND HIS FLEET SETTING SAIL FOR INDIA IN 1497

BALBOA SEES THE PACIFIC

Canal. The account of the Spanish arrival is typical: "After having performed their devotions, the Spaniards fell resolutely on the Indians, whom they soon routed, and then went to the town, which they found full of provisions to their wish." This reminds us of the saying about the Puritans of New England, that after landing at Salem they "first fell on their own knees and then upon the aborigines," as the Indians were called.

Balboa was made leader, and marched his men up among the mountains, where they found houses filled with cotton, besides plates of gold of large value. What followed is described by Mr. Synge in his excellent work, "A Book of Discovery":

"A trade in gold was set up by Balboa, who became governor of the new colony formed by the Spaniards; but the greed of these foreigners quite disgusted the native prince of these parts.

"'What is this, Christians? Is it for such a little thing that you quarrel? If you have such a love of gold, I will show you a country where you may fulfill your desires. You will have to fight your way with great kings whose country is distant from our country six suns.'

"So saying, he pointed away to the south, where he said lay a great sea. Balboa resolved to find this great sea. It might be the ocean sought by Columbus in vain, beyond which was the land of great riches where people drank out of golden cups. So he collected some two hundred men, and started forth on an expedition full of doubt and danger. He had to lead his troops, worn with fatigue and disease, through deep marshes rendered impassable with heavy rains, over mountains covered with trackless forest, and through defiles from which the Indians showered down poisoned arrows.

"At last, led by native guides, Balboa and his men struggled up the side of a high mountain. When near the top he bade his men stop. He alone must be the first to see the great sight that no European had yet beheld. With 'transports of delight,' he gained the top and, 'silent upon a peak in Darien,' he looked down on the boundless ocean, bathed in tropical sunshine. Falling on his knees, he thanked God for his discovery of the Southern Sea. Then he called up his men. 'You see here, gentlemen and children mine, the end of our labors.'

"The notes of the 'Te Deum' then rang out on the still summer air, and, having made a cross of stones, the little party hurried to the shore. Finding two canoes, they sprang in, crying aloud joyously that they were the first Europeans to sail on the new sea, whilst Balboa himself plunged in, sword in hand, and claimed possession of the Southern Ocean for the King of Spain. The natives told him that the land to the south was *without end*, and that it was possessed by powerful nations who had abundance of gold. And Balboa thought this referred to the Indies, knowing nothing as yet of the riches of Peru. It is melancholy to learn that the man who made this really great discovery was publicly hanged four years later in Darien. But his news had reached Magellan. There was, then, a great Southern Ocean beyond the New World." Thus Balboa accomplished more than he knew.

CORTES EXPLORES MEXICO

The West Indies were from the days of Columbus the starting place for Spanish exploration. From this center the coast of Florida was discovered in 1513, and the Pacific by Balboa in the same year. In 1517 a little fleet was fitted out from there under Francisco Hernando de Cordova, "a man very prudent and courageous and strongly disposed to kill and kidnap Indians." He discovered Yucatan, with "strange-looking towers or pyramids, ascended by stone steps, and people who came out in canoes to watch the ships — people who were clad in quilted cotton doublets and wore cloaks and brilliant plumes." These people resented the landing of the Spaniards and killed many of them, including the commander. Before his death he sent an account of his voyage to the governor of Cuba, and soon the coast of this great new country was explored by young Grijalza, who had Columbus' old pilot, Alvarado, to guide him. "Mexico, Mexico," repeated the Indians, who produced gold and gold ornaments until the explorer returned enthusiastic over the new land where lived a powerful ruler, surely none other than Marco Polo's Great Khan.

This show of gold was Mexico's undoing, for now comes Hernando Cortes, described as young, bold, devout, and unscrupulous — a great combination. Prescott tells us all about him. He became conqueror of Mexico, and his little army of four hundred and fifty men would have had little to hope had not King Montezuma and his people regarded the white men as directly from the gods, and Cortes as the long-lost Child of the Sun. Sailing from Cuba February 18, 1519, Cortes landed on the spot where Vera Cruz now stands, and encamped there. He sent presents to the Great Khan, as he thought, and Montezuma sent back presents so wonderful that Cortes resolved to see the city which produced such wealth. Here was a plate of gold as large as a coach-wheel, representing the sun, one in silver, representing the moon, besides numbers of golden toys in shapes of dogs, lions, tigers, apes, and ducks, and wonderful feather plumes. Building a little settlement at Vera Cruz, "the Rich Town of the True Cross," he set out for the capital. But in order to take his men with him, he was compelled to burn his ships, so that they could not sail for home. His march was not opposed, because the natives fled in awe before them. It was three months, hard months, before they reached the golden city of Mexico. Then they shouted, "It is the promised land! Mexico!"

Wonderful sight it was as the valley of Mexico unfolded itself before them in the early light of a July morning. Water, cultivated plains, and shining cities lay like some fairyland before and below them. The city was approached by three solid causeways five miles long. This was crowded with spectators "eager to behold such men and animals as had never been seen in that part of the world." For the rest of the story, read Prescott. It is more like romance than history. It tells of the Spanish treachery, of Montezuma's refusal to accept the new faith, and his final appeal to his subjects; then chains, degradation, and death; also of the three great heaps of gold, pearls, and precious stones taken by Cortes, and of the final siege and conquest. It was a bad and


Fernand Cortès

TOP: DEATH OF MONTEZUMA BY TREACHERY. CORTES CONQUERING THE MEXICANS
BOTTOM: TORTURING THE HAPLESS NATIVE CHIEFS. CORTES PROCLAIMING MEXICO AS SPANISH BY CONQUEST

bloody beginning in poor Mexico, and things have been bad there pretty much ever since the white man broke in upon the natives, who had a remarkable civilization of their own.

PIZARRO AND PERU

Pizarro was a man much like Cortes, bold and cruel, ready to dare anything, and his march to the heart of Peru in 1532 was like Cortes' march to Mexico. Both coveted rich empires and practiced treachery upon the natives, who in both cases were betrayed by their religious traditions of white men, Children of the Sun — the Peruvians being sun-worshipers. Aided by this feeling of reverence and dread, Pizarro was able to put the King Atahualpa to death in the most treacherous manner, and to complete the conquest of Peru. He entered Cuzco, a city of marvelous treasure, as conqueror. But not long did he enjoy rule. The spirit of adventure was too strong in him, and he set out to penetrate the remote regions of the interior. He had three hundred and fifty Spaniards, half of them horsemen, and four thousand Indians. Their sufferings were intense. Thunderstorms and earthquakes terrified them, and one quake swallowed up five hundred houses. The cold in the Andes was so great that many were frozen to death, and the food gave out, so that they had to live on wild fruit. Horses were killed to feed the sick. They discovered the mighty river, the Amazon, but, after two years' absence in Peru, Pizarro arrived home again, with only eighty men left out of the four thousand three hundred and fifty who started, all the rest having perished. In his search for the El Dorado his men had been obliged to eat their shoes, and saddles boiled with wild herbs, and to fight with Amazons, the women fighting as valiantly as the men.

FRANCISCO PIZARRO (1478–1541)

This Spanish Conqueror of Peru was born in Trujillo, Italy. He was with Balboa when the Pacific was discovered, and set off with Almagro for the conquest of Peru. He was assassinated at Lima in 1541.

EARLIEST MAP OF PERU

TOP: PIZARRO FIGHTING THE PERUVIANS. PIZARRO BEFORE THE KING OF PORTUGAL. BOTTOM: FIGHTING IN SOUTH AMERICA. DEATH OF PIZARRO BY ASSASSINATION

JOHN CABOT AND NEWFOUNDLAND

The shiploads of gold sent to Spain aroused the English people, and Venetian John Cabot, and his son Sebastian, after learning of the voyage of Columbus, resolved to do some exploring. Bristol was at this time the chief seaport in England, and various little expeditions had been fitted out there for westward exploration, but all failed. After the success of Columbus, John Cabot got leave from Henry VII of England "to sail to the east, west, or north, with five ships carrying the English flag, to seek and discover all the islands, countries, regions, or provinces of pagans in whatever part of the world." The king was to have one fifth of the profits, and conflict with Spain must be avoided. Cabot started off in a tiny ship with eighteen men. The record is brief: "In the year 1497 John Cabot, a Venetian, and his son Sebastian discovered on the 24th of June, about five in the morning, that land to which no person had before ventured to sail, which they named Prima Vista, or first seen. The inhabitants use the skins and furs of wild beasts for garments, which they hold in as high estimation as we do our finest clothes. The soil abounds in white bears and deer much larger than ours. Its coasts produce vast quantities of large fish — great seals, salmons, soles above a yard in length, and prodigious quantities of cod." Cabot thought he had found the country of the Great Khan. A letter of the time tells how "Master John Cabot has won a part of Asia without a stroke of the sword." This was all Master John did, and he and his son gave England her claim to Newfoundland.

THE CARAVELS OF DE SOTO

Hernando De Soto (1500–1542), Spanish soldier and explorer, assisted Pizarro in conquest of Peru (1532); first to cross the Mississippi (April, 1541); died of fever in 1542. When Governor of Cuba he explored Florida and the interior, reaching the Mississippi near Vicksburg.

HOW THE FRENCH CAME TO CANADA

It was Jacques Cartier, the Frenchman, who won for France a large tract of land about the river St. Lawrence in Canada. When new land was discovered, it was claimed by the country under whose flag the discoverer sailed. Thus we have seen how Spain had a claim to the West Indies and South America, although Columbus was an Italian; and England a claim to Newfoundland, although Cabot was a Venetian. Cartier sailed under the flag of his own country, and when he explored the Gulf of St. Lawrence he claimed it for France. He was really trying to find a way across America to Cathay, that land of gold which was the goal still. With two little ships of sixty tons and sixty-one chosen men, sailing from St. Malo, April 20th, 1534, he made the coast of Newfoundland in three weeks. The ice drove him south, and during May and June he explored the gulf.

Prince Edward Island appealed to him strongly, "as very pleasant to behold." It was "full of wild corn, red and white gooseberries, strawberries, and blackberries, as if it had been cultivated," he says in his report. Then he sailed back home, on the way "being much tossed by a heavy tempest, from the east, which we weathered by the blessing of God."

He was commissioned to find out more about the land he had discovered, and sailed again in May, 1535, with three ships, which sailed a stormy sea, but after five weeks of fog and gales reached Labrador, and presently entered a "very large and fine bay, full of islands." Cartier named it "Baye Saint Laurens,"

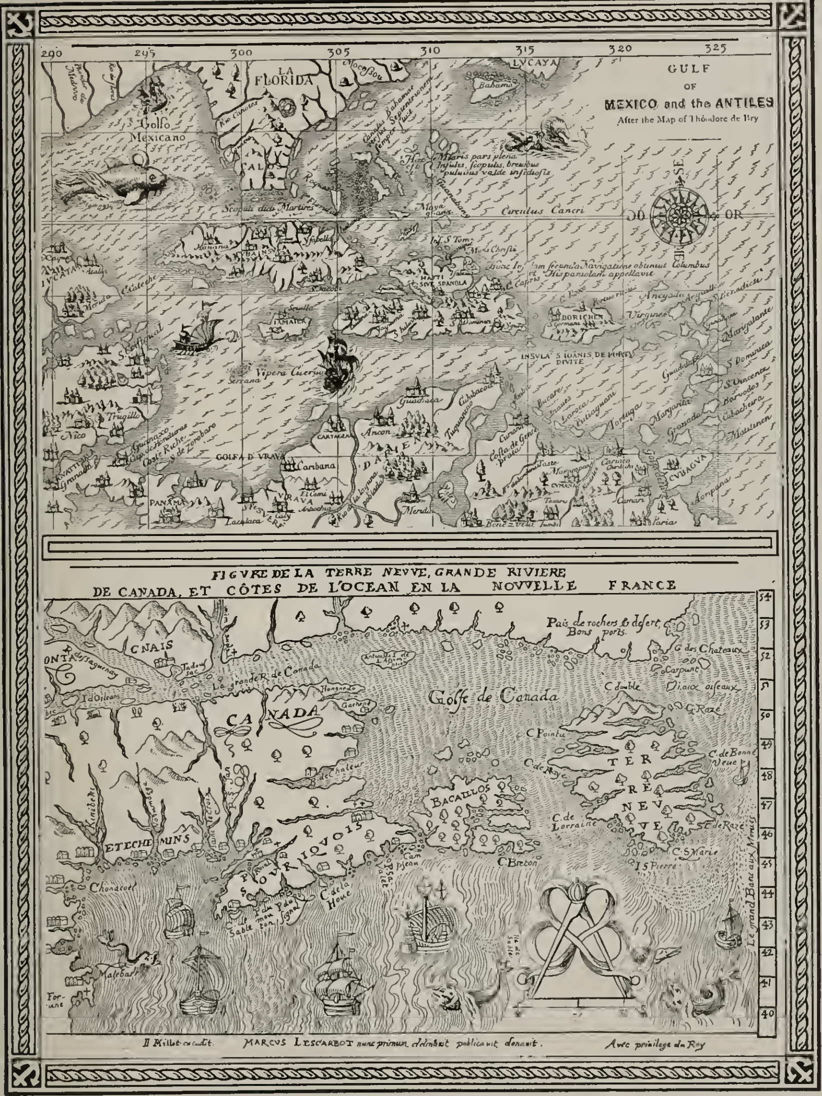
FOUNDER OF NEW FRANCE IN AMERICA

because he entered it on August 10 — the feast of St. Lawrence, as the English spell it. "Savages" told him he was near the mouth of the great river Hochelaga (now the St. Lawrence), which became narrower as they approached Canada. "Canada" was just a native word for town or village. The Indian "lord of Canada" came down the river with twelve canoes and many of his people to greet the first white men he had ever seen. Cartier sailed up the unknown river for a week, finding a pleasant, well-wooded country, with "vines as full of grapes as they would hang." At the native town of Hochelaga he was welcomed by hundreds of natives, who received them "as if we had been of their own nation come home after a long and perilous absence." The women carried their children to him to touch them, plainly thinking that some supernatural being had come up from the sea.

The next morning Cartier, "having dressed himself splendidly," went ashore with some of his men, all armed, and marched along a well-beaten track to the Indian city, which stood in the midst of cultivated fields of Indian corn. The people met them with signs of gladness, and the king, who wore a red wreath made of hedgehog skins round his head in place of a crown, placed this crown on the head of the French commander, before whom he bowed as before a god. The people had the same idea, for they brought their blind, lame, and diseased for him to cure. Touched with pity at their confidence, Cartier signed them with the sign of the cross; then "opened a service book and read in an audible voice, during which the natives kept a profound silence, looking up to heaven and imitating all our gestures."

Cartier and his men then went to the top of the near-by mountain. The view made a deep impression upon him, as it still does upon the beholder, and he called the place Mont Royal — a name perpetuated in the busy city of Montreal of to-day — for it was to the site of Montreal that he had come.

Winter overtook him, and he chose a spot between Montreal and Quebec for winter quarters. A hard time they had of it, for they had never known such a climate; scurvy broke out; and by the middle of February out of one hundred and ten persons not ten were in perfect health, while eight were dead already. From November to March four feet of snow lay upon the decks of the little ships. Yet the record makes no complaint. "It must be allowed that the winter that year was uncommonly long"— that is all. Glad enough were they to make for home in May, with the great news that, while a way to Cathay had not been found, they had discovered and taken a great new country for France. And that is the way France got its first hold upon the New World; and the French are in Canada still, though England controls all of Canada, through the conquests of war, which is another story, to be read in history and not in exploration.



AMONG THE EARLIEST MAPS MADE OF THE GULF OF MEXICO AND GULF OF ST. LAWRENCE

These maps are not only picturesque but remarkably accurate when it is considered that they were made not long after these lands were first explored.

SIR FRANCIS DRAKE

SIR FRANCIS DRAKE, THE FIRST ENGLISHMAN TO SAIL ROUND THE WORLD

A famous voyage was that of Sir Francis Drake (1577–80), for although it was made fifty years after Magellan had sailed round the world, Drake was the first Englishman to do so, and his experiences were thrilling. Drake was a character. Apprenticed to the master of a small ship at fifteen, he had not only sailed on the North Sea, but crossed the Atlantic in 1567 with his kinsman, John Hawkins. His new attempt was the piratical one of seizing a Spanish port in America and carrying away its treasure. In this he failed, but he did something else, for he was the first Englishman to see the Pacific, having climbed the ridge dividing the two oceans very much as Balboa did. Climbing a giant tree, he saw the Golden Sea, Magellan's Pacific Ocean, washing the shores of Mexico and Peru far below him. Descending to the ground he sank upon his knees and "humbly besought Almighty God of his goodness to give him life and leave once to sail in an English ship in that sea." In 1573 he carried the news to England, and drew Queen Elizabeth into a scheme to make a raid into this Spanish territory and take some land for England. Ships were bought for a "voyage to Egypt." Four ships and a hundred and fifty men made up the expedition, which was bound for Alexandria, as the crews and public thought.

Once out at sea, Drake had to announce the real voyage, and made straight across the Atlantic. Sailing from Plymouth on November 15, 1577, it was the 5th of April following when Brazil was sighted, but fogs and storm separated the vessels and they had to run into the mouth of La Plata for safety. Then they struggled southward for six long weeks, battered by gales and squalls which tested all the skill of the navigators. By June 20 they had reached Magellan's Port St. Julian on the shores of Patagonia, and there saw the skeleton of the mutineer hanged by Magellan a half-century before. Strangely enough Drake had a traitor in his second officer, Doughty, and he called a council, tried him, and on his condemnation had him executed and left his body as a second warning of "the end of traitors." After six weeks in harbor during midwinter, they sailed to the Straits of Magellan, which they entered only to encounter tempests of wind and snow which swept down from the towering mountains. Fires lit by the natives on the coast added terror to the wild scene. After sixteen days of this they were again in the open sea. It was the Pacific, but a terrible tempest drove the ships helplessly southward and westward far beyond Cape Horn. When they once more reached the coast it was to find no harbor, and one ship foundered in the gale, while a second turned back homeward, leaving Drake in his flagship, the *Golden Hind*, to make his way alone. After nearly two months of storm, he anchored among islands south of any at that time known, where the Atlantic and Pacific rolled together in one boisterous flood. Walking alone to the farthest end of the island, Drake is said to have lain down and with his arms embraced the southernmost point of the known world. He found that Tierra del Fuego, instead of being part of a great continent, was a group of islands. The Silver Map of the World, struck on a me-

dallion in Holland about 1581, first shows this discovery.

DISCOVERY OF SAN FRANCISCO HARBOR

Sailing along the western coast of South America, he reached Valparaiso, where a large Spanish ship laden with treasure from Peru was overhauled and plundered, this being one of Drake's methods of gaining wealth. As he went on to Lima and Peru he chased other ships of Spain, and took on board so much stolen Spanish treasure that he did not dare sail homeward by that coast. So he resolved to go northward and see if there was a way home in that direction. They got as far as Vancouver Island, and probably put in for shelter at the harbor of San Francisco and to make repairs for the long voyage across the Pacific and home by the Cape of Good Hope. He named this country New Albion, and the Indians treated him as kindly and reverently as the Canadian Indians had treated Cartier. Their king took off his crown and put it upon Drake's head, making him understand that the land was now his. "Before we left," says the chronicler, "our General caused to be set up a monument of our being there, as also of Her Majesty's right and title to that kingdom, namely, a plate of brass, fast nailed to a great and firm post, whereon is engraved Her Grace's name and the day and year of our arrival here, and of the free giving up of the province, both by the people and king, into Her Majesty's hands. The Spanish never so much as set foot in this country — the utmost of their discoveries reaching only to many degrees southward of this place."

The Indians looked upon these white men as gods, and were disconsolate when Drake prepared to leave, giving every evidence of grief — burning fires and making sacrifices at their departure. Thus did England secure a claim on the Pacific Coast.

Drake left New Albion on July 23, 1579, reached the Philippines after sixty-eight days of straight sailing, stayed for two months in the Spice Islands, where his men repaired the ship, first ate "figo," and then ran across the Indian Ocean, rounded the Cape of Good Hope in calm weather, and so came home, reaching Plymouth harbor three years after leaving it, and long after he had been given up as lost. The news that an Englishman had sailed round the world set England ablaze with enthusiasm. The queen listened spellbound to Drake's story, and paid him the unusual honor of attending a banquet on board the little *Golden Hind*, at which she knighted him, and ordered that the ship should be preserved "as a worthy rival of Magellan's *Victoria*," and as "a monument to all posterity of that famous and worthy exploit of Sir Francis Drake." The ship was afterwards taken to pieces, and the best parts of wood were made into a chair at Oxford. Drake died at sea in 1596. Of him and his ship the poet Cowley wrote:

ELIZABETH KNIGHTING FRANCIS DRAKE ON THE DECK OF HIS FLAGSHIP

"To this great ship, which round the world has run
And matched in race the chariot of the sun . . .
Drake and his ship could ne'er have wished from fate
A happier station or more blest estate;
For lo, a seat of endless rest is given
To her in Oxford and to him in Heaven."

HENRY HUDSON AND HIS SON CAST ADRIFT IN HUDSON BAY

HENRY HUDSON, WHO DISCOVERED THE HUDSON RIVER AND HUDSON'S BAY

Many victims have perished in the hopeless search for a passage to China by the north, and one of the noblest was Henry Hudson, who gave his name to the Hudson River, which he ascended as far as Albany, and to the great Bay in the Arctic regions, where he perished through the treachery of his crew. He was first employed by the Muscovy Company, a rival of the East India Company, "to discover a shorter route to Cathay by sailing over the North Pole." On the map that looked easy, but Hudson knew the fate of Willoughby and Frobisher, Barents and Davis, and certainly man never undertook a more perilous voyage than did he, when he started for the North Pole in a little eighty-ton boat, with his little son Jack, two mates, and a crew of eight men.

See the picture: "Led by Hudson with the fire of a great faith in his eyes, the men solemnly marched to St. Ethelburga Church, off Bishopsgate Street, London, to partake of Holy Communion and ask God's aid. Back to the muddy waterfront, opposite the Tower, a hearty God-speed from the gentlemen of the Muscovy Company, pompous in self-importance and lace ruffles — and the little crew steps into a clumsy river-boat with brick-red sails."

At the end of six weeks the little *Hopewell*, coated with ice, reached the coast of Greenland, and Hudson sailed along the edge of the ice barrier farther than any explorer had been before and farther than anyone got for a hundred and fifty years afterward. Whale Bay, on our maps, is one of the names he gave on that first voyage to the land of the walrus, seal, and polar bear. Fog and ice hung round the little ship, and, while Hudson wished to push on, the men wanted to go home, and home they went.

Hudson was under the lure of the north, and he made another expedition the next year, without result. This discouraged the Muscovy Company. But now the Dutch, who were vying with the English for the discovery of a short route to India, asked Hudson to make an expedition for the Dutch East India Company. So he sailed from Amsterdam this time, in the spring of 1609, in the *Half Moon*, with a mixed crew of Dutch and English. As always, his son went with him, and we would give much if that boy could have told his story. Reaching Newfoundland, Hudson turned south, partly

seeking a westward opening, partly looking for the Virginia colony, which was in charge of Captain John Smith, a friend of Hudson's. They cruised along the coast in hot, misty weather, passing what is now Massachusetts, "an Indian country of great hills — a very sweet land." By August 7 Hudson was near the harbor of New York, as we know it, but fog and a hurricane drove him almost to the James River before he could make way back again towards the charted coast to the north. On September 2 he came to the mouth of the great river that bears his name, and here is his description of the discovery:

"After beating about in gales and fogs, at last the sun arose and we saw the land all like broken islands. From the land which we had first sight of, we came to a large lake of water, like drowned land, which made it to rise like islands. The mouth hath many shores and the sea breaketh on them. This is a very good land to fall in with, and a pleasant land to see. At three of the clock in the afternoon we came to three great rivers. We found a very good harbor and went in with our ship.

"Then we took our nets to fish and caught ten great mullets of a foot and a half long each, and a ray as great as four men could haul into the ship." That is Hudson's first fish story, and a pretty fair one. "The people of the country came aboard of us, seeming very glad of our coming, and brought green tobacco. They go in deerskins, well dressed, they desire clothes and are very civil. They have great store of maize, whereof they make good bread. The country is full of great and tall oaks." He adds that the women had red copper tobacco pipes, many of them being dressed in mantles of feathers or furs.

EXPLORING THE HUDSON

Sailing up the river, he found it a mile broad, with high land on both sides. By September 19 the little *Half Moon* had reached the site of Albany. In something over a fortnight he had sailed for the first time the distance covered to-day by magnificent steamers which ply daily between Albany and New York City. Hudson now went ashore with an old chief of the country. "Two men were dispatched in quest of game," so records Hudson's manuscript, "who brought in a pair of pigeons. They likewise killed a fat dog and skinned it with great haste with shells. The land is the finest for cultivation that ever I in my life set foot upon."

Hudson had not found a way to China, but he had found a great river and given the Dutch a hold on the new continent by right of discovery.

HUDSON'S LAST SEARCH FOR THE NORTHWEST PASSAGE AND HIS DEATH BY TREACHERY

Still he was not content. That northwest passage must exist and he must find it. The next year, 1610, he was bound once more for the north. But now he sailed for the English again, and his son Jack was with him on the *Discovery*, a little ship of fifty-five tons. The crew was mixed, with a treacherous old man as mate; and a tragedy was preparing. Hudson made a good crossing, steered for Greenland, and was soon battling with the ice, sailing into the great straits that bear his name to-day. For three months they sailed about that "labyrinth without end," but could find no opening. Winter was coming on, the nights were long, and the earth was covered with snow. They were land and winter bound in a desolate region, but with a six months' supply of food. Mutiny started, however, and the men said, "We would rather be hanged at home than starved abroad." When Hudson saw that his hope of discovering a westward passage was gone, he "fitted all things for his return, and first delivered the bread out of the bread room (which came to a pound apiece for every man's share), and he wept when he gave it unto them." It was barely enough for fourteen days, and made the outlook desperate. In June the *Discovery* was headed homeward, but ice soon stopped her. Now the mutiny broke out. There were ruffians in the crew, wild with hunger and privation. It is well said that there is nothing more tragic in the history of exploration than the desertion of Hudson and his young son in their newly discovered bay. The conspiracy is known — how the crew resolved to turn the "master" and the sick men adrift and to share the remaining provisions among

themselves, and how in the early morning Hudson was seized and his arms bound behind him. "What does this mean?" he cried. "You will know soon enough when you are in the shallop," was the answer. The boat was lowered, and Hudson, his son Jack, and the sick and lame men were put into it, with some powder and shot, an iron pot, and some meal; and then the little boat was set adrift in that icebound sea. The ship's carpenter at the last moment leaped into the boat, resolved to die with the master rather than desert him. The *Discovery* put up all sail and hastened away. How the poor men on the boat perished is unknown. The mutineers took home Hudson's journals and charts. Ships were sent out to search for the lost explorer, but no trace was ever found.

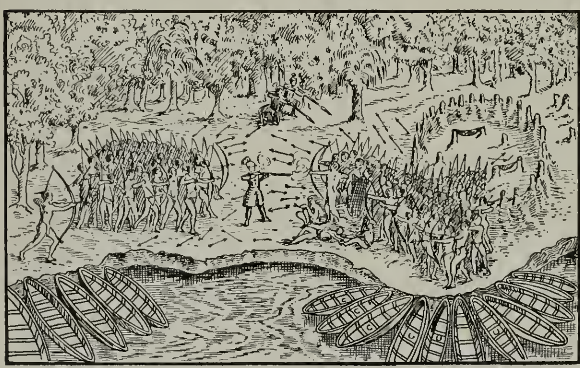
Remember that this was only ten years before the Pilgrims landed at Plymouth.

CHAMPLAIN, DISCOVERER OF LAKES

The first to explore the St. Lawrence west of Montreal, and to discover Lake Champlain, to which he gave his name, and Lake Ontario, was Samuel de Champlain, a veteran of the wars of Henry IV of France. It was in 1608 that he arrived with orders to establish an industrial colony which should "hold for France the gateway of the Golden East." He chose Quebec, an Indian word meaning the "strait," or "narrows," as the site for his colony, and after the winter was over went up the St. Lawrence in a little two-masted boat, piloted by Indians. When he came to the rapids, with two companions as brave as himself, he took a canoe and continued his journey, which was most perilous because of the Indians, who were now hostile and afraid, since Cartier had carried away some of them by treachery years before, and the white man was distrusted. They explored Lake Champlain, over a hundred miles long, with its beautiful mountain setting. Near the rocky point where Fort Ticonderoga was built later, they met a party of Iroquois; and while Champlain and his two men, clad in full armor, because of their arquebuses and powder won that fight, they had to give up further exploration and make for Quebec. In 1613 he started out again, and accomplished his great desire — the discovery of Lake Ontario, first of the great chain of inland lakes. Champlain died in Quebec in 1635. He was called the Father of New France; he founded Quebec and Montreal, and he explored Canada as no other man had ever done. He was one of the bravest and best of the explorers.

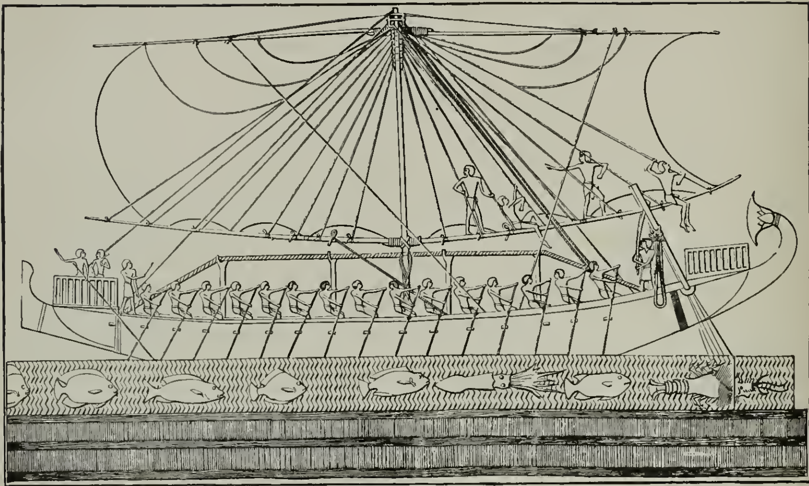
AS FOR THE OTHERS

Of course there were others — Davis, Barents, Behring, Vancouver, Frobisher, forerunners of Franklin, Nansen, and Peary in the Frozen North; there were Livingstone, Burton, and Speke in Africa. The list of explorers is a long one, and we hope you will like these stories so well that you will get the books, like Archibald Williams' "The Romance of Early Exploration" and "The Romance of Modern Exploration"; M. B. Synge's "A Book of Discovery"; and "The Romance of Missionary Exploration." All these are thrilling books, full of fascination, and better than the best made-up story.



CHAMPLAIN'S FIGHT WITH THE IROQUOIS

CELEBRATED PATHFINDERS OF FORMER TIMES



EGYPTIAN SHIP OF THE PUNT EXPEDITION. ABOUT 1600 B.C. (*An ancient print*)

EXPLORATIONS AND DISCOVERIES AT A GLANCE

A RECORD FROM THE EARLIEST TIMES, CONVENIENT FOR REFERENCE

ANCIENT

	DATE
The oldest known Ships	B.C. 6000–5000
Expedition to Punt, or Somaliland	1600
Phœnician Expeditions	700
Neco's Fleet built	613
Anaximander, the Greek, invents Maps	580
Hecatæus writes the First Geography	500
Hanno sails down West Coast of Africa	450
Herodotus describes Egypt	446
Xenophon crosses Asia Minor	401
Pytheas discovers the British Isles and Thule	333
Alexander the Great finds India	327
Nearchus navigates the Indian Ocean	326
The Geography of Eratosthenes	240–196
Julius Cæsar explores France, Britain, Germany	60–54
Strabo's Geography	A.D. 18
Agricola discovers the Highlands	83
Ptolemy's Geography and Maps	159
Pliny's Geography	170

MIDDLE AGE

	DATE
The First Guide for Travelers	420
St. Patrick explores Ireland	432–493
St. Columba reaches the Orkney Isles	563
The Christian Topography of Cosmos	600
Naddod the Viking discovers Iceland	861
Othere navigates the Baltic Sea	890
Erik the Red discovers Greenland	985
Anglo-Saxon Map of the World	990
Leif discovers Newfoundland and North American Coast	1000
Maffio and Niccolo Polo reach China	1260–1271
Marco Polo's Travels	1271–1295
Ibn Batuta's Travels through Asia	1324–1348
Sir John Mandeville's Travels published	1372

MODERN

Prince Henry of Portugal encourages Exploration	1418
Zarco discovers Madeira	1420
Tristan da Cunha discovers Cape Blanco	1441
Gonsalves discovers Cape Verde Islands	1442
Cadamosto reaches the Senegal River and Cape Verde	1455
Fra Mauro's Map	1457
Diego Gomez reaches the Gambia River	1458
Diego Cam discovers the Congo	1484
Bartholomew Diaz rounds Good Hope	1486

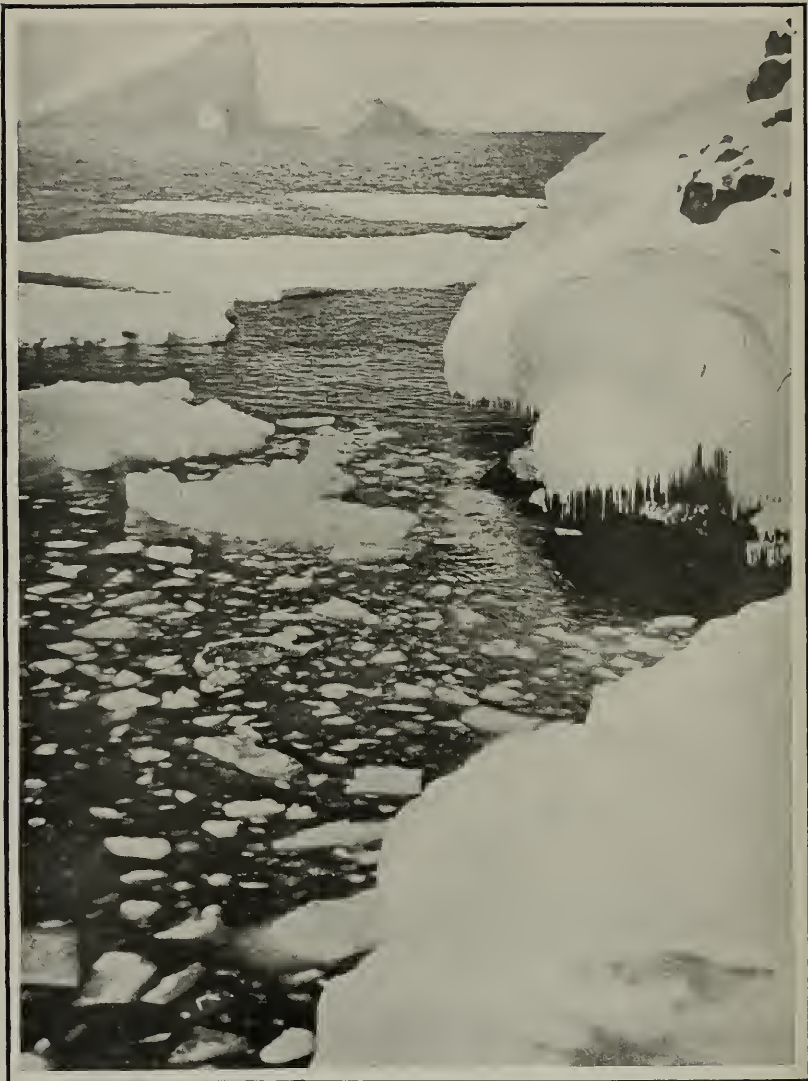
	DATE
Martin Behaim makes his Globe	1492
CHRISTOPHER COLUMBUS discovers West Indies	1492
Columbus finds Jamaica and other Islands	1493
Vasco da Gama reaches India by the Cape	1497
Cabot sails to Newfoundland	1497
Columbus finds Trinidad	1498
Amerigo Vespucci finds Trinidad and Venezuela	1499
First Map of the New World by Juan de la Cosa	1500
Pedro Cabral discovers Brazil	1500
Death of Columbus	1504
Francisco Serrano reaches the Spice Islands	1511
Balboa sees the Pacific Ocean	1513
Juan Grijalva discovers Mexico	1518
Cortes conquers Mexico	1519
The First Circumnavigation of the World by Magellan	1519–1522
Pizarro conquers Peru	1531
Jacques Cartier discovers the Gulf of St. Lawrence	1534
Orellana discovers the Amazon	1541
Pinto claims the discovery of Japan	1542
Sir Hugh Willoughby finds Nova Zembla	1553
Martin Frobisher discovers his Bay	1576
Drake sails round the World	1577–80
Davis finds his Strait	1586
Sir Walter Raleigh explores Guiana	1595
Barents discovers Spitzbergen	1596
Torres sails through his Strait	1605
Hudson sails into his Bay	1610
Champlain discovers Lake Ontario	1615
Baffin discovers his Bay	1616
Le Maire rounds Cape Horn	1617
Tasman finds Tasmania	1642
Dampier discovers his Strait	1698
Behring finds his Strait	1741
Captain Cook discovers New Zealand and Australia	1769–70
Bruce discovers source of Blue Nile	1770
Captain Cook discovers the Sandwich Islands	1778
Mackenzie discovers his River and British Columbia	1789–93
Vancouver explores his Island	1792
Mungo Park reaches the Niger	1796

POLAR AND AFRICAN

	DATE
Bass discovers his Strait	1798
Ross discovers Melville Bay	1818
Parry discovers Lancaster Sound	1819
Franklin reaches the Polar Sea by Land	1819–22
Parry's discoveries on North American Coast	1822
Franklin names the Mackenzie River.	1825
Clapperton reaches the Niger	1826
Parry attempts the North Pole by Spitzbergen	1827
Réné Caillé enters Timbuktu	1829
James Ross finds the North Magnetic Pole	1830
Ross discovers Victoria Land in the Antarctic	1840
Franklin discovers Northwest Passage	1847
Livingstone crosses Africa from West to East	1849–56
Burton and Speke discover Lake Tanganyika	1857
Speke sees Victoria Nyanza	1858
Livingstone finds Lakes Shirwa and Nyassa	1858–64
Speke and Grant enter Uganda	1861
Baker discovers Albert Nyanza	1864
Livingstone finds Lakes Meoro and Bangweolo	1868
Stanley finds Livingstone	1871
Livingstone dies at Ilala	1873
Stanley finds the Mouth of the Congo.	1877
Nordenskiold solves the Northeast Passage	1879
Nansen reaches Farthest North	1895
Younghusband enters Lhassa	1904
Peary reaches the North Pole	1909
Amundsen reaches the South Pole	1911
Scott's Death after reaching the South Pole	1912

OLDEST KNOWN SHIPS (6000 TO 5000 B.C.)

NANSEN'S "FRAM," POLAR SHIP (1896)



Copyright, Boston Photo News Co.

IN THE POLAR SEA

The ice barrier which confronts explorers of the arctic regions.

STORIES OF ADVENTURE

SIR JOHN FRANKLIN

IN 1845 Sir John Franklin, an officer in the British Navy and a veteran explorer, was put in command of two vessels, the *Erebus* and the *Terror*, with orders to search for the long-sought Northwest Passage. When no news of this expedition was heard for two years, alarm was felt for the safety of Franklin and his men, and relief parties were sent out in an attempt to rescue them. Thus began a quest which for ten years was watched with sympathetic interest by the whole world.

It was not from England alone that these expeditions were dispatched. America and France also assisted in the search, voluntarily supplying ships and men to help in solving the mystery of the missing vessels. Party after party, both private and public, numbering altogether about forty and following each other in rapid succession, set out on their mission of humanity, some of them to end in disaster, and most of them to add nothing to the solution of the distressing enigma. It was not till 1854 that any real light was shed upon the fate of Sir John Franklin and the courageous men who had accompanied him. Returning from a search instituted by the Hudson's Bay Company, Dr. John Rae reported having met with a party of Eskimos who told him that about six years before they had fallen in with a company of white men dragging their boats and sledges over the ice, and who by signs communicated to them the fact that their ships had been crushed in the ice. Later on, the Eskimos had discovered the boats and graves of many of these men. In proof of their story, they produced silver spoons and forks, which Dr. Rae purchased from them, and, as these objects had without doubt belonged to the missing expedition, the story of the Eskimos was unhesitatingly accepted in England, and Rae and his party were paid the reward of £10,000 ($50,000) offered for tidings of the expedition.

There seemed little more to learn; but Lady Franklin, wonderfully brave and patient during her long and trying ordeal, was not yet satisfied. Eager to learn more particulars of her husband's fate, she determined that another search should be made, and at her own expense equipped and stored an expedition. Captain McClintock was invited to the command, and many old shipmates, his companions in previous arctic voyages, volunteered their services. The *Fox*, a small steam yacht of 160 tons, was chartered for the enterprise and provisioned for a two years' absence, the Government, although declining to be responsible for the expedition, liberally assisting.

It seemed too much to expect that, where so many other expeditions had failed, the little *Fox* would meet with success; but after being locked up in the ice-pack for eight months, daily in danger of being crushed to pieces in the floes, the tiny vessel reached the region that had been the scene of Franklin's imprisonment, and discoveries were made which helped materially in reading the riddle of the ill-fated expedition.

From the discoveries of Rae and McClintock, it is possible to trace with tolerable accuracy the movements of Franklin and his party from the point at which they disappeared. Grim, indeed, is the tragedy that was at length revealed — the weary imprisonment amid the ice during the long winters of endless darkness and the short summers of unfailing light, the hope of relief that never came, the merciful passing away of the gallant old commander before the final catastrophe with its relentless doom fell upon his brave men, the abandoning of the ships to their fate, and the toilsome march

over the ice in the vain struggle to escape death, — that was the terrible story of the expedition which, full of hope and confident of success, had sailed from England in 1845.

The first winter was spent at Beechey Island, comfortably enough, no doubt, for the terrors which latterly fell in such abundance were undreamed of, and, well-provisioned as the vessels were, there would be no lack of food. There three of the men and two seamen and a marine died. When the summer of 1846 arrived, Franklin attempted to move southward, the two ships bravely struggling among the grinding icebergs of Peel Sound and Franklin Strait, but making little advance against the difficulties that barred their progress. Early in September the winter suddenly began, and to the north of Cape Felix, the most northerly point of King William's Land, the *Erebus* and the *Terror* were again bound in the iron grip of the frozen sea and held there, bandied backward and forward by the shifting ice in surroundings as terrible as the human mind can conceive, and in constant dread that the frail ships would be ground to pieces by the pressure of the frozen mountains among which they were imprisoned.

In the spring of 1847, Lieutenant Graham Gore of the *Erebus*, accompanied by another officer and six men, was dispatched with sledges to King William's Land, and reaching Point Victory deposited there the following brief record of the circumstances in which the expedition then stood and of the experiences that lay behind: "28th May 1847. — H.M. ships *Erebus* and *Terror* wintered in the ice in lat. 70° 5′, long. 98° 23′ W., having wintered in 1846 and 1847 [should obviously read 1845 and 1846] at Page Island in lat. 74° 43′ and long. 91° 39′ W., after having ascended Wellington Channel, lat. 77°, and returned by the west side of Cornwallis Island. Sir John Franklin commanding the expedition. All well. Party consisting of two officers and six men left ships on Monday, May 24, 1847. Graham Gore, lieutenant; Charles F. Des Voeux, mate."

About a year later, a mournful addition was made to this record, after the lapse of another winter in the ice — the third since leaving England. On the 25th April, 1848, the message left by Lieutenant Gore in its cairn of stones was removed and then returned to its resting-place after the following words had been written round the margin: "H.M. ships *Terror* and *Erebus* were deserted on the 22nd April, five leagues northwest of this, having been beset since 12th September 1846. The officers and crews, consisting of 105 souls, under the command of Captain F. R. M. Crozier, landed here in lat. 69° 37′ 42″ N., long. 98° 41′ W. Sir John Franklin died on the 11th June, 1847; and the total loss by deaths in the expedition has been to this date nine officers and fifteen men. F. R. M. Crozier, captain and senior officer; James Fitzjames, captain, H.M.S. *Erebus*." To that intimation were appended these words: "And start to-morrow for Back's Fish River."

"All well," reads the first message, suggesting that there was as yet no premonition of the coming calamity. But much happened before the tragic addition was made to that brief statement. When Sir John Franklin died there was still the anticipation of ultimate success; but the short Arctic summer came and went, and the ships remained bound in the vast ice-pack. Then another dreary winter set in, bringing added fears and terrors with it as the prospect of release from the icy prison seemed more remote than ever. The spring of 1848 came on, and Captain Crozier, who had succeeded to the command of the party after the death of Sir John Franklin, felt that the only chance of life was to abandon the ships.

Accordingly, on 25th April, 105 souls took to the ice, boats placed on runners and sledges having been prepared, with the intention of journeying to the mainland by way of Back's Great Fish River, the mouth of which was 250 miles away from the spot at which the vessels then lay. It was a cold and dismal as well as dangerous journey, and one that must have been undertaken only when no other escape seemed possible and when the failure of the provisions rendered it absolutely necessary. What happened on that fatal march can be gathered from the story of the Eskimos, who told Dr. Rae that they sold seal's flesh to the white men, while from a band of the same people McClintock learned that the Englishmen dropped their drag-ropes on the march and died where they fell. A scanty remnant of about forty men, according to the estimate of the Eskimos, reached the vicinity of the

Great Fish River, battling with the energy of despair against the resistless fate that was surely overtaking them, and that left not even one of them to tell the story of suffering and death.

The expedition had succeeded in demonstrating the existence of the long-sought Northwest Passage, having connected Lancaster Strait with the navigable channel that extends along

THE LAST MAN OF ALL ON THE FRANKLIN EXPEDITION

the continent to Bering Strait, and thus uniting a known track on the east with a known track on the west.

The Northwest Passage, which for centuries had been the dream and the goal of navigators, defying them again and again, had been discovered at last, and thus the men who had left all and dared all to follow the call of duty were conquerors even in their death.

KANE'S ATTEMPT TO RESCUE FRANKLIN

AMONG the brave men who attempted to find traces of Sir John Franklin was an American named Dr. Elisha Kent Kane, who commanded an expedition sent out in the brig *Advance*. In all the literature of Polar exploration and adventure there is little to compare with the record of suffering and endurance set forth in the journal of the heroic commander. For twenty-one months the vessel containing the search-party was firmly locked in the very jaws of death. Provisions ran short, scurvy and other diseases attacked the crew, again and again accidents happened which threatened the life of all the expedition, for weeks and months on end starvation stared everyone in the face, and it seemed as if there could be no escape from the vast network of cruel circumstances. But amid it all Kane's marvelous confidence in ultimate relief never wavered. He hoped on when everyone else was resigned to death, and eventually led his diminished band back to civilization across a stretch of ice and water for thirteen hundred miles, after their vessel, no longer of service to them, had been abandoned to its fate.

The departure was made from New York on May 30, 1853, and two months later we find the *Advance* off the coast of Greenland in imminent peril from the ice. The ship was fastened to an iceberg, and had barely time to cast off before the face of the berg fell in ruins, "crashing like near artillery." The passage through Melville Bay was made without mishap, and then in the waters farther northward the old enemy of navigation in these regions was encountered. "Directly in our way," reads the journal entry for August 20, "just beyond the line of floe-ice against which we were alternately sliding and thumping, was a group of bergs. We had no power to avoid them, and the only question was, whether we were to be dashed in pieces against them, or whether they might not offer us some providential nook of refuge from the storm. But, as we neared them, we perceived that they were at some distance from the floe-edge, and separated from it by an interval of open water. Our hopes rose as the gale drove us towards

this passage and into it; and we were ready to exult, when, from some unexplained cause — probably an eddy of the wind against the lofty ice-walls — we lost our headway. Almost at the same moment we saw that the bergs were not at rest, that with a momentum of their own they were bearing down upon the other ice, and that it must be our fate to be crushed between the two.

"Just then a broad sconce-piece or low water-washed berg came driving up from the southward. The thought flashed upon me of one of our escapes in Melville Bay, and, as the sconce moved rapidly close alongside us, M'Garry managed to plant an anchor on its slope and hold on to it by a whaleline. It was an anxious moment. Our noble towhorse, whiter than the pale horse that seemed to be pursuing us, hauled us bravely on, the spray dashing over his windward flanks and his forehead plowing up the lesser ice as if in scorn. The bergs encroached upon us as we advanced; our channel narrowed to a width of perhaps forty feet; we braced the yards to clear the impending ice-walls. We passed clear; but it was a close shave — so close that our port quarter-boat would have been crushed if we had not taken it in from the davits—and found ourselves under the lee of a berg, in a comparatively open lead. Never did heart-tried men acknowledge with more gratitude their merciful deliverance from a wretched death."

Reaching latitude 78° 43′ N., the *Advance* was frozen up, and then, with the long night already upon them, the party settled down to the experiences of an Arctic winter. From the very outset the difficulties and dangers descended thick and fast. The sledge-dogs fell into chasms; the sledge parties met with disasters, and were rescued only after heroic efforts; disease and death were already busy among the men; and by the beginning of April Kane is lamenting the fact that the week just ended has left him nothing to remember but anxieties and sorrow. Nearly all the party were then tossing in their sick-bunks, some frozen, others undergoing amputations, several with dreadful premonitions of tetanus. By the end of the month came the short season available for Arctic search and, though the condition of things on board the brig was far from satisfactory, the leader pushed ahead with the preparations for renewed exploration.

Sledge parties started off from the vessel; but on the 20th of May, Dr. Kane, propped up by pillows and surrounded by sick messmates, records the fact that he has again failed to force the passage to the north. Scurvy had broken out among the men; some of them suffered from snow-blindness; the leader himself, fainting and delirious, was saved from death only by the devotion of five of his men, themselves scarcely able to move; and, in addition, the heavy snows rendered traveling extremely difficult. It was thus a disappointed and discouraged party that returned to the shelter of the brig, much before the time anticipated, with nothing to show but trouble and defeat.

It is characteristic of Kane that, as soon as he recovered enough to be aware of his failure, he began to devise means for remedying it. Determining to trust almost entirely to the dogs for travel in the future, Kane dispatched Hayes on a sledge journey of exploration, which succeeded in connecting the northern coast with the survey of a previous expedition; but it disclosed no channel or any form of exit from the bay in which the brig lay. Dr. Kane was convinced, however, that such a channel must exist, "for this great curve could be no *cul-de-sac.*" To verify this theory he immediately began the organization of a double party, the field of which was to be the hundred miles wanting to the northeast to complete their entire circuit of that frozen water. Two sledge parties were dispatched, and returned in safety after their survey, which did little to solve the doubts and difficulties of the situation.

The season of arctic travel had again ended. The summer was wearing on, but still the ice did not break up as expected, and as far as could be seen it remained inflexibly solid between the expedition and the North Water of Baffin Bay. On the 8th of July, Dr. Kane, reviewing the situation, takes a rather despondent view of their being able to find a passage through the pack-ice. He is afraid that, in the event of trying to force a passage, the winter may set in before they can get halfway through. "There never was," he mournfully writes in

his journal, "and I trust never will be, a party worse armed for the encounter of a second Arctic winter. We have neither health, fuel, nor provisions. Dr. Hayes, and indeed all I have consulted, despond at the thought; and when I look around upon our diseased and disabled men, and think of the fearful work of the last long night, I am tempted to feel as they do."

The alternative of abandoning the vessel at that early stage of the enterprise did not commend itself to the commander, for he felt that, even if it were possible, it would be dishonoring; but revolving the question as one of practicability alone he would not undertake it. But still his mind is shadowed by a doubt. What is he to do? "In the first place," we find him arguing with himself, "how are we to get along with our sick and newly amputated men? It is a dreary distance at the best to Upernivik or Beechey Island, our only seats of refuge, and a precarious traverse if we were all of us fit for moving; but we are hardly one half in efficiency of what we count in number. Besides, how can I desert the brig while there is still a chance of saving her? There is no use of noting pros and cons: my mind is made up; I will not do it."

Determining to examine the ice-field for himself, Kane started off on a long sledge journey, and as a result of this survey he resolved to attempt in person to communicate with Beechey Island, knowing that if he could reach Sir Edward Belcher's squadron he would be sure of the much-needed assistance. He was quite aware that this was a hazardous venture, but he realized at the same time that it was an incumbent duty, and, while he would have been glad to delegate the task to a subordinate, he felt that he had no right to devolve this risk upon another, and, besides, he was the only one possessed of the necessary local knowledge of Lancaster Sound and its ice-movements. Taking with him five men and the boat, named the *Forlorn Hope*, which was mounted on a large sledge till the open water was reached, the little party proceeded on its southern journey, fighting daily with ice-floes, being nipped in the ice, and hauling the boat on the floes, sometimes a dozen times a day, to escape the pressure of the floating masses.

At last, on July 31, "at the distance of ten miles from Cape Parry, we came to a dead halt. A solid mass lay directly across our path, extending onward to our farthest horizon. There were bergs in sight to the westward, and, by walking for some four miles over the moving floe in that direction, M'Garry and myself succeeded in reaching one. We climbed it to a height of a hundred and twenty feet, and, looking out from it with my excellent spy-glass to the south and west, we saw that all within a radius of thirty miles was a motionless, unbroken, and impenetrable sea."

Naturally, this was disappointing. It was obvious that a further attempt to penetrate to the south must be hopeless till the ice-barrier should undergo a change, and there was nothing for it but to return to the brig and face another winter among the ice, with all the miseries which such a situation involved. "It is horrible — yes, that is the only word," wrote Kane in his diary when the prospect of release dwindled away, "to look forward to another year of disease and darkness to be met without fresh food and without fuel. I should meet it with a more tempered sadness, if I had no comrades to think for and to protect."

A few days later it was made clear beyond all doubt that the brig could not escape; and, calling the officers and crew together, Kane frankly explained the considerations which had determined him to remain where he was. He endeavored to show them that an escape to open water could not succeed, and that the effort must be exceedingly hazardous; but he was perfectly willing to give his permission to such as were desirous of making the attempt. Eight out of the seventeen survivors of the party resolved to stand by the brig; the resources were divided, and on Monday, August 28, "the party moved off with the elastic step of men confident in their purpose, and were out of sight in a few hours." Months later, however, after many trials and hardships, and when they had failed in their purpose, the men who had departed so hopefully returned to the ship to share once more the unhappy fortunes of their suffering comrades.

It is not to be wondered at that the departure of half of the crew had its effect on those who remained behind, and that dark and dreary

forebodings should occupy their every thought. "The reduced numbers of our party, the helplessness of many, the waning efficiency of all, the impending winter, with its cold, dark night, our penury of resources, the dreary sense of increased isolation — these," wrote Kane, at this critical period of their imprisonment, "made the staple of our thoughts. For a time Sir John Franklin and his party, our daily topic through so many months, gave place to the question of our own fortunes — how we were to escape, how to live."

AN EXTRAORDINARY ESCAPE

The problem of how to live was certainly not an easy one to solve. But something had to be done, and one day a sealing expedition was organized. During the progress of the hunt, the party passed upon a new belt of ice that was obviously unsafe. It was more than a mile to the nearest lump of solid ice, and to reach it the dogs were urged on with whip and voice, the ice rolling like leather beneath the sledge-runners. Everything depended on the dogs. A moment's check would plunge the whole concern into the rapid tideway. It was a desperate race against fate. Nearer to the floe dashed the sledge, and the worst seemed over when, within fifty paces from the solid ice, the dogs suddenly paused, terrified by the rolling of the tough salt water. The left-hand runner went through, the leader, "Toodlamick," followed, and a second later the entire left of the sledge was submerged.

Leaning forward to liberate the dogs, Kane found himself swimming in a little circle of pasty ice and water. "I succeeded in cutting poor Tood's lines," he afterwards wrote, in describing these moments of horror, "and letting him scramble to the ice, for the poor fellow was drowning me with his piteous caresses, and made my way for the sledge; but I found that it would not buoy me, and that I had no resource but to try the circumference of the hole. Around this I paddled faithfully, the miserable ice always yielding when my hopes of lodgment were greatest. During this process

Courtesy of Doubleday, Page & Co.

DOG SLEDGE AND HUSKIES ON THE TRAMP IN THE FAR NORTH

I enlarged my circle of operations to a very uncomfortable diameter, and was beginning to feel weaker after every effort. Hans meanwhile had reached the firm ice, and was on his knees, like a good Moravian, praying incoherently in English and Eskimo; at every fresh crushing-in of the ice he would ejaculate 'God!' and when I recommenced my paddling he recommenced his prayers. I was nearly gone. My knife had been lost in cutting out the dogs; and a spare one which I carried in my trousers pocket was so enveloped in the wet skins that I could not reach it. I owed my extrication at last to a newly broken team-dog, who was still fast to the sledge, and in struggling carried one of the runners chock against the edge of the circle. All my previous attempts to use the sledge as a bridge had failed, for it broke through, to the much greater injury of the ice. I felt that it was a last chance. I threw myself on my back, so as to lessen as much as possible my weight, and placed the nape of my neck against the rim or edge of the ice; then, with caution, slowly bent my leg, and, placing the ball of my moccasined foot against the sledge, I pressed steadily against the runner, listening to the half-yielding crunch of the ice beneath. Presently I felt that my head was pillowed by the ice, and that my wet fur jumper was sliding up the surface. Next came my shoulders; they were fairly on. One more decided push, and I was launched up on the ice and safe. I reached the ice-floe, and was frictioned by Hans with frightful zeal. We saved all the dogs; but the sledge, kayak, tent, gun, snowshoes, and everything besides were left behind."

This was not the only escape from a watery grave experienced by the explorer and his comrades as they settled down to winter in their inhospitable quarters; but death by drowning was nothing compared with the fearful dread of starvation, which was scarcely absent for a single day. Mournful, indeed, are the entries which are to be found in the journal of the brave commander, who, with unquenchable resource and determination, struggled against a combination of circumstances that would have dismayed and overcome any ordinary man. Unlike the previous winter, Kane, throughout his long and trying ordeal, remained in wonderfully good health, and thus he was able to minister to the needs of the others when, but for his sympathetic care, they would have sunk under their load of afflictions.

It makes melancholy reading to come across such entries as these: "M'Garry and Brooks are sinking rapidly. Walrus beef alone can sustain them, and it is to be got from the natives, and nowhere else." "Our only diet will be a stock of meat biscuits, to which I shall add for myself — Petersen's taste is less educated — a few rats, chopped up and frozen into the tallow-balls." "I have fed the dogs the last two days on their dead brethren. Spite of all proverbs, dog will eat dog, if properly cooked. I have been saving up some who died of fits, intending to use their skins, and these have come in very opportunely. I boil them into a sort of bloody soup, and deal them out twice a day in chunks and solid jelly; for of course they are frozen like quartz rock. These salt meats are absolutely poisonous to the northern Eskimo dog. We have now lost fifty odd, and one died yesterday in the very act of eating his reformed diet." "I found an overlooked godsend this morning — a bear's head put away for a specimen. There is no inconsiderable quantity of meat adhering to it, and I serve it out raw to Brooks, Wilson, and Riley." "There is no evading it any longer; it has been evident for the past ten days that the present state of things cannot last. We require meat, and cannot get along without it. We have about three days' allowance; thin chips of raw frozen meat, not exceeding four ounces in weight for each man per diem. Our poor fellows eat it with zest, but it is lamentably little." "On Sunday, the 4th (March), our last remnant of fresh meat had been doled out. Our invalids began to sink rapidly. The wounds of our amputated men opened fresh."

And so on from day to day, the same sad story of disease and starvation. Once or twice, when things were at their worst, a little relief was obtained from the Eskimos; but they themselves had passed through a serious famine, and were not able to render much assistance. Again and again everything seemed at an end with the disabled and utterly disheartened party; but Kane never lost hope, and was able to impart some of his own confidence to his comrades.

At last, with the approach of spring, bringing with it the possibility of a way out, it was decided to leave the ship, and arrangements were carefully made for the journey of alternating ice and water of more than thirteen hundred miles. On May 20, a solemn farewell to the brig was made. It was Sunday, and after prayers and the reading of a portion of Scripture, all standing silently round, Kane addressed the party. He did not affect to disguise the difficulties that were before them; but he assured the men that all could be overcome by energy and subordination to command, and that the thirteen hundred miles that lay between them and North Greenland could be traversed with safety for most of them, and with hope for all.

There were many dangers on the journey, and all the party suffered severely from the exposure and the want of food. One man died; but after eighty-four days in the open air the perilous undertaking was accomplished, and with grateful hearts the explorers stood once more with the solid earth beneath their feet.

THE "JEANNETTE" EXPEDITION

ONE of the most heroic and tragic attempts to reach the North Pole was that made by Lieutenant George Washington De Long, of the United States Navy, in the steamship *Jeannette*. De Long believed in the existence of a current running north through Bering Strait. He thought that the warm waters of this current would open a way along the coast of Wrangel Land, possibly to the Pole itself.

Well equipped for her mission, the *Jeannette* sailed from San Francisco on July 8, 1879, and, steaming her way northward towards Wrangel Land, found herself, by the beginning of September, among the drifting ice-floes. Watching his opportunity, De Long steered his ship into the ice-pack, thus boldly putting to the test his theories with regard to the drift which he was optimistic enough to believe would carry him to his goal. For a few days he sailed about in the floating mass, and then the ice closed around him, and the *Jeannette* was locked in her frozen prison, to remain in that deadly embrace until, two years later, she was crushed between the floes, leaving the brave men who had patiently shared her fortunes homeless on the terrible ice.

The winter, which set in rapidly, passed in comparative comfort. There were frequent gales, some of them of a destructive character; the ice was restless during part of the time, the ship experiencing many strains and jars. On November 14 the sun disappeared from view, and was not again seen till the end of January, the whole of which month was full of danger to the *Jeannette* and her occupants. Threatened by the great masses of grinding ice, rising in some places to a height of fifty feet, which inclosed her on every side, the vessel seemed doomed, and it looked as if she would have to be abandoned. But the danger passed for a time, and, remaining in her chamber of frozen blocks, she drifted with the merciless ice till the shore of Wrangel Land, which had up till that time been visible, disappeared from view towards the end of February.

The summer came and went, and still the explorers were surrounded by the icy walls which offered no channel of escape. The life of weary inactivity was telling upon the spirits of the men, and even De Long himself was discouraged by the long imprisonment. Already they had spent a trying year in the grip of the floes, and as another winter was rapidly approaching it was only too obvious that the prospect of liberation was as far removed as ever. Soon the long night of darkness once more fell upon the disheartened party, and they waited with what patience they could command for the return of the daylight, hoping that with it might come some alleviation of the depressing monotony which was so hard to bear.

The steady drift northward brought the *Jeannette* again within sight of land. On May 16, 1881, to the great relief of all on board, including the commander, an island was seen in the distance, to which De Long gave the name of Jeannette Island; and eight days later land was again seen, and a party going off from the ship to investigate it found it to be an island, and named it Henrietta Island.

About the beginning of June, it was apparent that a change was coming over the situation,

and that a crisis might be upon them at any moment. The ice pressed more severely than ever upon the vessel, causing the timbers to crack and seams to open, and everyone on board was convinced that the chances of the *Jeannette* holding together under the circumstances were very remote indeed. De Long and his comrades were considering what it was best to do, whether to leave the ship or wait for further developments in the doubtful hope of the pressure lessening, when the moving floes, bearing down upon the boat and crushing her between them, made instant action imperative. All around the ice was splitting up, and jammed by the huge masses the *Jeannette* lay in a hopeless position. On June 12 orders were given to abandon the ship. There was no panic, for such a contingency had long been foreseen, and every man knew his duty, and set about performing it. The colors were hoisted to the masthead, boats, sledges, and provisions were lowered on to the ice, De Long calmly superintending these operations from the bridge, smoking his pipe the while, as if he had no part in the tragedy going on around him. The ship heeled over, even while this work was being carried out, until it became impossible to stand on deck without holding on to something. At last, when all the indispensable articles had been transferred, De Long followed his men on to the ice, being the last to leave, and waving his cap and crying, "Good-by, old ship!" as he leaped to the floe to join his companions.

DE LONG SIGNALING MELVILLE TO GO FORWARD

Deprived of the shelter of the *Jeannette*, it was not a cheering prospect that faced the stout-hearted band. They were five hundred miles from the mouth of the Lena River, the nearest point of succor. Some of the men were ill, and the food-supply was dangerously low; but, hastily putting aside the dismal outlook, they set about preparing a camp, and then lay down to sleep, forgetting the troubles of the day just ended and leaving the morrow to take care of itself.

A few hours later, the giant floe split with a noise like thunder, waking the camp and bringing to the much-tried party a new set of terrors. One crack came directly into the camp through De Long's tent, and "had it not been for the weight of the sleepers on either side of the rubber-blanket," Melville tells us, "those in the middle must inevitably have dropped into the sea. As it was, they were rescued with great difficulty.

When the camp awoke there was no ship, the *Jeannette* having sunk about four o'clock in the morning, and there upon the cruel ice, far removed from a place of safety, stood the gallant band about to begin the desperate fight that for most of them was to end in death. But as yet they had not a full conception of the horrors that lay ahead, and, like men, faced the unknown with a smile upon their faces and with hope in their hearts.

Almost a week was spent in preparation, and then began the long and trying journey towards the south. It was hard dragging, that had to be performed over the sodden snow that soaked

the men as they marched; but they could not risk leaving anything behind. The load consisted of two cutters, a whaleboat, the sledges laden with tents, and provisions to last sixty days. Owing to the heavy hauling it was necessary to travel the same road several times. Frequently the sledges sank in the soft snow and broken ice, and only by combined effort could they be extricated. With the view of lightening the difficulties of the march, De Long altered the hours of traveling, performing the journey by night instead of by day in the hope that the track, in the absence of the sun's rays, would be more firm and therefore easier to traverse. But in spite of the hardships of the journey and the almost daily wettings, the men pulled with wonderful cheerfulness, and, although they wore the soles of their moccasins right through to their stockings, and sometimes stood with bare feet on the raw ice, not a word of complaint passed their lips.

Land and water were sighted on July 11. The party landed on what proved to be an island, and De Long, taking possession of it in the name of God and the United States, named it Bennett Island. The explorers remained there until the boats were repaired, and then once more resumed their weary and perilous journey. Their next landing was on one of the New Siberian Islands, where a camp was pitched on a mossy plain close to the shore. Again they left land behind and embarked on the water, De Long commanding one of the cutters and Lieutenant Chipp the other, while Chief Engineer Melville had charge of the whaleboat. Up to a certain stage the dangers and difficulties of the journey had been confined to the snow and ice; now these were transferred to the water, a change that did not make for increased comfort or safety. The cutter containing Chipp and his men, being smaller and slower than the other two boats, was unable to make the same progress through the waves, and was soon left in the rear, but again joined the others, who had waited for their missing companions on an ice-floe, just as they were beginning to fear that they had been lost in the gale.

Once more in their boats, they proceeded on their journey, the sea running high and the waves constantly washing over them, at one time in clear water, at another in the midst of a whirling mass of broken ice, sometimes pulling for their lives to escape destruction from a floe, and all the time on an allowance of food that barely sufficed to keep life in their bodies. It was by this time almost the middle of September, and hope, so long dimmed and uncertain, was beginning to return, as Cape Barkin, the point which they desired to reach, was now less than ninety miles distant. Just before reëntering the boats, after a brief halt, De Long asked both Chipp and Melville to keep within hail, if possible, and repeated his instructions as to the course to be pursued should they be separated. "Make the best of your way," he said, "to Cape Barkin, which is eighty or ninety miles off. Don't wait for me, but get a pilot from the natives and proceed up the river to a place of safety as quick as you can, and be sure that you and your parties are all right before you trouble yourselves about anyone else. If you reach Cape Barkin you are safe, for there are plenty of natives there winter and summer." Then, addressing himself to Melville, he said, "You will have no trouble in keeping with me; but if anything should happen to separate us, you can find your way in without difficulty by the trend of the coastline, and you know as much about the natives and their settlements as anyone else."

The boats had not been long on their way before the sea rose considerably, and by evening there was such a hurricane blowing that it seemed utterly impossible to live through it. Attempting to slacken speed and thus keep in the wake of the first cutter, according to orders, the whaleboat narrowly escaped being swamped; and, as Melville was engaged in his fierce fight with the elements, he noticed that De Long was gesticulating to him and shouting something which could not be heard above the roar of the wind and waves. Shouting down the wind to his commander that he must either run or swamp, Melville eagerly waited for some sign of reply. His words seemed to reach De Long, who, realizing the imminent peril of the whaleboat, waved his arm and signaled her onward. Under additional sail the whaleboat then leaped forward, and speedily outdistanced the first cutter. Looking back to ascertain the whereabouts of the cutters, Melville saw Chipp's boat, in the far-off dim

twilight, rise for a moment on the crest of a wave and then sink out of sight. Keeping his eye on the place where he saw her disappear, he anxiously waited to see her come again to the surface; but though the waves rose and fell around the spot the boat was not again seen, and as nothing further was ever learned about the cutter's fate Melville was convinced that that was the moment when she took her final plunge, burying beneath the tossing waves the lieutenant and his men.

Meanwhile, De Long's cutter was keeping afloat with the greatest difficulty. Much water was shipped, the mast and sail were carried away, and, tossed about on the tempestuous sea, the helpless boat was in momentary danger of sinking. At last, after four awful days of misery, every minute of which threatened death, the cutter came within sight of land, and when about a mile from the Siberian shore she ran aground. A raft was hastily constructed, and, pushing it through the frozen water, the wet and exhausted men gradually reached the land.

They had escaped the terrors and dangers of the sea; but the terrors of the land, just as grim and awful as any yet experienced, had yet to be faced. Utterly worn out, they lay down on the ground to sleep, and rose up in the morning, soaked to the skin, to meet the miseries of cold and hunger. Leaving everything behind that could possibly be spared, they set out in search of a settlement where they could find shelter and food. It was a pitiable procession. There was not one strong man in the company, for the long battle on the floes and on the sea, combined with the want of food, had drained their strength till they could scarcely crawl. Slowly and feebly they pushed on over the barren ground. They had little to eat, and already some of the party were falling down in their weakness. Reaching a couple of deserted huts, after being several days on their way, they rested for three days, and then, feeling slightly refreshed, resumed their toilsome march. One day a deer was shot, giving them enough to eat for a few days. On they tramped till not a scrap of food remained, and in desperation their dog was shot to provide them with a meal. Completely exhausted, one man died, and his companions, too weak to bury him, dropped him into a river. Seeing the terrible state of their comrades, two of the men, Nindemann and Noros, started off ahead in the hope of finding help.

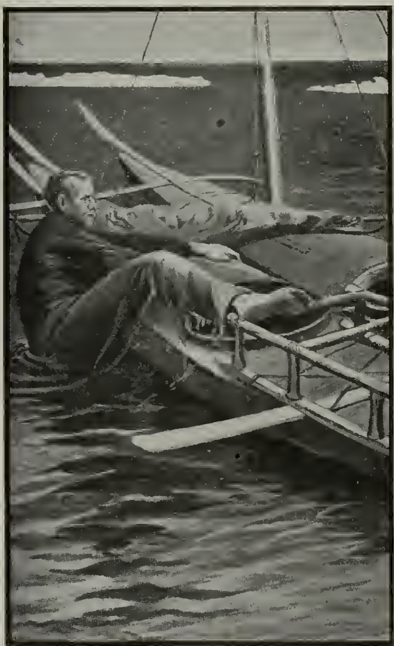
It was now the middle of October, and winter, with all its terrors, held the broken men in its fatal grip. There was nothing to eat, and, unable to continue the struggle, they sat down to wait the end. One by one the little party that had undergone so many hardships and fought so hard for their lives, were overcome and lay down to die, one of them passing away in his sleep as he lay between De Long and the doctor. As long as he was able to hold a pen, the brave leader noted in his journal the deaths of his companions, the last entry being on October 30, when he recorded the fact that four of the men had died since the 28th. There the tragic story ends. On the frozen ground lay the bodies of commander and men, the latest victims of that awful land of desolation. Like so many others before them, they had hoped to conquer the secrets of the Frozen North; but where they looked for victory and honor, they found defeat and death.

Little more remains to be added with regard to the fate of the *Jeannette* expedition. After many buffetings by wind and waves, the whaleboat succeeded in reaching land, without a man missing, and falling in with some natives Melville and his men were kindly treated. Nindemann and Noros, pushing on from De Long's party, were reduced to terrible straits before they had gone far on their journey. Unable to find food on the desolate wastes, the famished men ate some pieces of the sealskin trousers which one of them was wearing. Coming to a deserted hut on October 19, they found a small quantity of moldy fish. This they ate, and were afterwards taken seriously ill. In their extremity they met an Eskimo, who brought them to his friends. They tried to make the natives understand that they wanted help for their comrades, but all their efforts in this direction failed. At a large settlement, called Balun, to which the Eskimos escorted them, they came across Melville, who, hearing of their arrival, had hastened to meet them. Melville heroically endeavored to go back on the tracks of Nindemann and Noros, hoping that he might yet be in time to

save some of De Long's party; but the difficulties that beset his path rendered the effort unsuccessful. In any case, the men whom he sought to relieve had passed beyond the reach of human help.

NANSEN'S NARROW ESCAPE

WHILE Fridtjof Nansen, the Norwegian explorer, and his companion, Johansen, were traveling along the edge of a great field of ice, they narrowly escaped losing the "kayaks," as the Eskimo canoes are called, in which they were making their journey. If they had lost the kayaks, the explorers would have been left on the ice without food or shelter, and with more than a hundred miles of icy water between them and the nearest land.

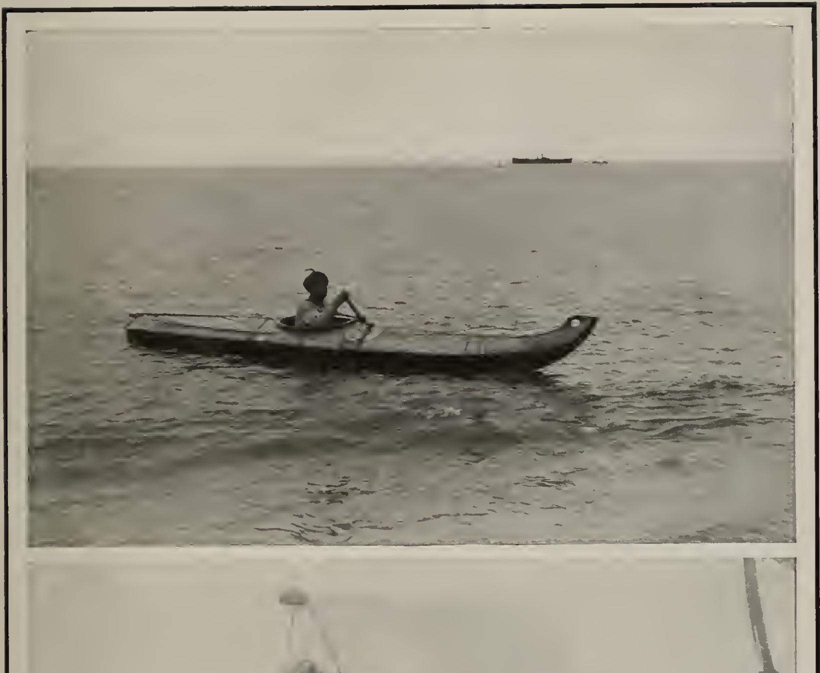


NANSEN'S NARROW ESCAPE

Putting in to the edge of the ice, when evening fell, that they might relieve their stiffened limbs by walking, they fixed their tiny canoes to the ice, and ascended a neighboring hummock in order to obtain a view over the water to the west. Suddenly Johansen cried out that the kayaks were adrift. Both men ran to the edge of the ice with all speed; but by the time they reached it, the canoes were already well out and drifting quickly off. Realizing that not a moment was to be lost, Nansen hastily threw off some of his outer garments and plunged into the ice-cold water. But it was hard work swimming with clothes on, and as the kayaks were drifting more quickly than he could swim he was very doubtful of his ability to reach them. But everything depended upon the result of his efforts. All they possessed was drifting from them on the slim boats, and Nansen well knew that life itself was in the balance. Swimming on his breast and back, alternately, Johansen watching him all the time from the ice-edge in an agony of mind, and utterly unable to render any assistance, Nansen fought his way through the water till his limbs stiffened and lost their feeling, and he was just on the verge of collapse when he reached the kayaks. With difficulty he pulled himself on board; but he was so stiff with cold that he could scarcely paddle ashore. Having succeeded so far, he was determined not to fail now, and making a mighty effort he brought the kayaks back to a place of safety, and though utterly exhausted and benumbed he quickly recovered.

ESKIMO TREACHERY

SIR JOHN FRANKLIN, the leader of the British expedition of 1825 to explore the northern coast of North America, was a young naval officer who had already served with distinction under Nelson in the battle of Trafalgar and taken part in two previous exploring expeditions.



ABOVE: AN ESKIMO IN HIS KAYAK. BELOW: AN INTERESTING ESKIMO FAMILY

On the 7th of July his boats gained the mouth of the Mackenzie, and Franklin discovered a number of Eskimos on an island. He resolved on visiting them, accompanied only by Augustus, his Eskimo interpreter, and told Lieutenant Back to keep the boats afloat, and the crews with their guns ready, but by no means to fire except as a last resort. The bay was shallow near the island, so that the boats touched the ground when a mile from the beach.

Shouting, and making signs to the Eskimos to come to the boats, Franklin ordered his men to pull into deeper water. At first three and then scores of kayaks covered the intervening space. The three foremost received the present offered them, and on Augustus detailing the object of the visit, and the prospect of a profitable trade resulting from it, they repeated what he said to the rest, who raised a deafening shout of applause. A brisk exchange of goods began. From two hundred and fifty to three hundred people thronged round the boats, all eager to share in the lucrative trade. Franklin, amid the din, could get no intelligence about the coast, and, finding their importunity troublesome, ordered the boats' heads put to seaward. The Eskimos did not thwart him; they even shoved the *Lion* off when it grounded in turning. Both boats, however, were fast aground, as the tide was ebbing, and the Eskimos said the whole bay was equally flat. Just at this moment a kayak was upset by one of the *Lion's* oars, and its owner plunged head foremost into the mud. Out of compassion he was taken into the *Lion*, and Augustus wrapped him in his own greatcoat. This fellow begged for everything he saw, and was very angry at being refused. He told his friends of all the bales and untold wealth he had seen in the *Lion*, and some of the younger ones tried to board the boat. Franklin's flag seemed the most coveted object, so he had it furled and stowed away, but finding it very hard to keep them off, he at last admitted two chiefs, on their promising to make the rest stand aloof.

Profiting by this respite, the *Reliance* got into deeper water, but the *Lion* stuck fast, and Lieutenant Back fastened a towline to her. The hero of the ducking was now discovered with a pistol under his shirt. He had stolen it from Back, and jumped out with it and Augustus's coat. By this time the water was only knee deep, and the younger Eskimos began slyly to steal everything within their reach. So Franklin told the two chiefs that he found himself much incommoded by such a crowd, and that, if they would go away for the present, he would come back another time and bring them a large present from the ship expected on the coast. They retired at once with cries of "Teyma." Franklin thought the danger was over, but was soon undeceived. They were only concerting a plan of attack, and at once began to haul the *Reliance* to the beach, smiling good-naturedly when Back remonstrated, and repeating the word "Teyma, teyma." To show they meant peace, they tossed their knives and arrows into the boat. The *Lion* tried to follow, but could not till the Eskimos dragged her. Two of the strongest jumped in, and, seizing Franklin by the wrists, forced him to sit between them, and as he shook them off, a third stood by to catch his arm whenever he tried to lift his gun or dagger. All this time they kept patting his breast with their hands and pressing his hands against their breasts. As soon as the *Reliance* was ashore, a number drew their knives, stripped themselves to the waist, and began a regular pillage of the boat, handing the articles to the women, who quickly conveyed them away. Back's men resisted, but were overpowered by numbers. One cut the buttons from Vivier's coat, and others, flourishing knives, gazed gloatingly at the anchor-buttons on Back's waistcoat. Then one young chief seated himself on his knee and drove the others off.

It was now the *Lion's* turn to be attacked. Franklin, with Augustus, had gone to the help of the *Reliance*, and Augustus, with great boldness, rushed among the crowd, reproaching them with their treachery. But Franklin was recalled to the *Lion* by Duncan, for there the assailants were brandishing their knives furiously, and stealing everything movable, trying in particular to carry off the box of astronomical instruments, till Duncan fastened it to his leg by a cord. Hitherto both sides had remained comparatively cool, in spite of the heavy blows which the Englishmen dealt with the butts of their muskets. But matters now grew

more serious. The savages, boarding the *Lion*, tried to wrest from the seamen their daggers and shot-belts. Back sent the friendly chief to the rescue, and he released Franklin just in time to enable him to prevent Wilson from shooting a man who had tried to stab him. But his own gun was immediately made the object of the struggle, when suddenly all the assailants ran away and hid themselves on the beach.

This sudden metamorphosis was produced by the leveled muskets of the crew of the *Reliance*, which Back had managed to get afloat. Then the *Lion* got into deep water, and when the Eskimos were again preparing to approach in their kayaks, Franklin bade Augustus tell them he would shoot the first man who came within musket-range. All this time the pillagers had stolen little of value, except some kettles, blankets, shoes, sails, and a tent. They would have been given all else they had purloined if they had waited. Franklin, with his usual generosity, lavished praise on the crews for their forbearance and coolness, which certainly they deserved; but it is none the less evident that it was mainly owing to his own exhibition of those qualities that a catastrophe was avoided.

SAVED BY FEIGNING DEATH

HOW THE STEADY-NERVED YANKEE FOOLED THE BLACK BEAR

BY the side of the grizzly, the American black bear, or musquaw, seems harmless and cowardly; but those who have lived much in the backwoods sometimes tell a different tale. Colonel Fremont, an American engineer, whose name was almost as well known in our fathers' time as Buffalo Bill's is in our own, was well qualified to write of these animals, for while he was engaged in the Missouri survey he was constantly meeting with them. While on his journey it was more than once Fremont's lot to be hard pressed for food; and on one occasion, pressed by famine so that his men had already eaten a pet dog, they determined that the first musquaw that put in an appearance should go to fill the larder.

It was not long before some of the party discovered a track. The black bear is easier to trace than any of his kind, from his habit of going continually over the same ground, often wearing a plainly marked path that the least-experienced eye could follow without difficulty. Two white men and two redskins were told off to track the animals, and the men in a very little time came upon a scene that they had scarcely anticipated. On a small treeless space were three black bears, one, a female, standing placidly by, while the other two, males, were grappling with one another in deadly combat.

One of the Yankees instantly shot the female, and she fell dead. His companion with his gun and the Indians with bows and arrows opened fire on the two combatants. One of these fell almost immediately, but the other, sufficiently wounded to be enraged without being disabled, dashed towards the hunters. The Indians seemed to care little for this, for they merely dodged from trunk to trunk of the trees, shooting an arrow as opportunity offered. But the Yankees, less active or less accustomed to this mode of hunting, hastened to climb the nearest tree.

Between so many assailants the bear hesitated, but at last decided on those in the tree and began to climb after them, slowly and with the greatest caution.

One of the Yankees, seated in an uncomfortable fork of the tree, had found time to reload his piece, and, leaning as far forward as he dared, fired at the head of the bear as he came to the level of the lowest bough. The animal dropped apparently dead, but the hunter had leaned just a little too far forward, and, before he could recover himself, fell headlong to the ground, where he lay as if stunned by the fall. At the same time a warning cry from the Indians, whose ammunition was exhausted, caused the other of the Yankees to look sharply. The first of the bears had only been wounded, and now gathered himself together to take a part in the proceedings.

The musquaw went straight up to where the injured man lay, sniffed at the body, turned it over with his paw, and at last squatted down reflectively by the side of it. The treed man

was now at his wits' end, for as long as the fallen man lay unconscious he was probably safe. After a while the brute rose and began to methodically tear away the earth near the body, as though preparing to bury it. Fearing now for his companion, the treed man no longer hesitated, but slid down the tree, snatched up his gun, and retreated to a point of vantage successfully. Having reloaded it he took careful aim, and this time the bear fell to rise no more. But to the shooter's astonishment his companion rose coolly and remarked, "I see him comin' before ever I fell out o' the tree. Reckon I took him in tolerable neat!"

THE CAPTIVE OF THE IROQUOIS

NOT long after the French had entered Canada in 1634, the Jesuits established a mission at Sault Sainte Marie, between Lake Huron and Lake Superior. The difficulties of the journey thither from Quebec are thus graphically described by Bancroft, the historian of the United States: "The journey by way of the Ottawa and the rivers that interlock with it was one of more than nine hundred miles through a region horrible with forests. All day long the missionaries had to wade or handle the oar. At night there was no food for them but a scanty measure of Indian corn mixed with water; their couch was the earth or the rocks. At five-and-thirty waterfalls the canoe had to be carried on their shoulders for leagues through thick woods or over roughest regions; fifty times it was dragged by hand through shallows and rapids over sharp stones; and thus — swimming, wading, paddling, or bearing the canoe across the portages with garments torn, with feet mangled — the consecrated envoys made their way by rivers, lakes, and forests from Quebec to the heart of the Huron wilderness."

Among the Hurons they made several converts, but the mission stations were kept in a constant state of alarm by the inroads of the Iroquois, or Confederacy of Five Nations, the hereditary foes of the Hurons. Excelling the Chinese in their love of horrible and strange tortures, these savages, obtaining firearms from the Dutch at Manhattan, used to lurk in the woods that lined the shores of the Great Lakes, waiting for the canoes that conveyed missionaries and supplies between Sainte Marie and Quebec.

The priests of Sainte Marie were men of imperturbable courage. Days and nights they spent in the Indian wigwams, half stifled by the smoke of the fires, by the light of which they wrote the remarkable letters which are still preserved.

In these letters we have a graphic account of the terrible sufferings of Father Isaac Jogues, one of the missionaries at Sainte Marie. In 1642 he had been sent to Quebec to obtain supplies, and on his return with Ahasistari, a Christian Huron chief, and other Hurons, as the canoes ascended the St. Lawrence, they were fired on and captured by a party of Mohawks.

When the rest of the Mohawks came back from the pursuit of the fugitive Hurons, they carried the captives across the river, and there shared the plunder of the twelve canoes they had taken. Raising then a joyful shout, the Mohawks bore off the Frenchmen and the Christian Hurons, consisting of twenty-two captives, three having been killed. Their sufferings on the journey (which lasted thirteen days) were great from hunger and heat and the hideous cruelty of the Indians. These savages, according to their practice with prisoners, tore out Father Jogues' finger-nails, except two, with their teeth. On the eighth day they fell in with a troop of two hundred Iroquois going out to fight. It was the custom of the Indian war parties to signalize their departure by deeds of cruelty, under the belief that their success would be greater in proportion as they had been more cruel. First rendering thanks to the sun, as the god of war, they congratulated their countrymen by firing off a volley of musketry. Then, arming themselves with clubs, as the prisoners landed from the canoes they beat them with such fury that Father Jogues, who was the last, and therefore the most exposed to their blows, sank before he had traversed half the rocky path which led to the scaffold which had been erected for the prisoners. When they had carried him there half dead and drenched with blood, they burned one of his fingers and crunched another with their teeth. One savage came up, and seizing his nose in one hand prepared to cut it off with a large knife which he

held in the other, but some unaccountable impulse restrained his hand. Had he accomplished his purpose, Father Jogues would probably not have been allowed to live, as Iroquois do not generally spare captives thus mutilated.

When they reached the first Iroquois village the captives had to run the gantlet between two lines of youths armed with clubs before they reached the stage erected for them. Here the same sickening scene of cruelty was reënacted, Father Jogues having his left thumb cut off by a Christian woman, compelled to perpetrate this act by violent threats.

At night the prisoners were stretched on the ground, their feet and hands being fastened to four stakes. Here during the hot August nights they suffered torments from insects without being able to move a limb. The children of the village, by way of apprenticeship in the art of cruelty, would come and lay hot coals and embers on them, which it was very difficult to shake off.

The captives had now for seven days been led from village to village and from scaffold to scaffold. On the eighth day they were told that they would be burned to death. Father Jogues, addressing the Christian Hurons for the last time, as he supposed, exhorted them to be of good courage. But the chiefs, on further consideration, determined that no precipitate step should be taken as regards the French prisoners, and, when they had summoned them before the council, told them that their lives would be spared. Three, however, of the Christian Hurons were put to death with cruel torture.

FATHER GOUPIL IS MURDERED

One day, as Jogues and Goupil were walking in a wood, the savages allowing them this degree of liberty, as they did not attempt to escape, they were accosted by two savages, who commanded them to return to the village. At the entrance to the village one of them dealt Goupil a blow on the head with his tomahawk which stretched him lifeless.

At the sight of the murderer's reeking hatchet, Father Jogues knelt down on the spot, and, uncovering his head, awaited a like blow. But when he had thus knelt a minute or two they bade him rise. Father Jogues learned afterwards that Goupil had been killed by the orders of an old Indian on whose grandchild he had made the sign of the cross, which they viewed with superstitious horror.

The next day Father Jogues went out to look for the body of his friend in order to bury it, but found that the Indians had contemptuously tied a rope around the neck, and, dragging it through the village, had flung it into a ravine at a considerable distance. Not being able to bury it that day he returned the next, but found

THE MURDER OF MISSIONARY GOUPIL

that the body had again been carried off. Only after the lapse of some time did he succeed in recovering some of the bones and the skull, which he interred.

FATHER JOGUES' WINTER OF CAPTIVITY

In the autumn, when the hunting season had come, Father Jogues was made to accompany

a hunting party to gather wood for them and to do other menial offices. At intervals he tried to preach to them, but they told him to desist, as they believed it spoilt their chances of catching game.

At night he had to sleep on the ground on rough bark, for though the Indians had plenty of deerskins they refused to let him have one.

Thus two more months passed, when he was sent back to the village bearing a heavy load of venison for the hunters. Seeing that his life was likely to be spared, he began to apply himself to the study of their dialect, for in their quieter moods the Indians would ask him many questions as to the sun, moon, and stars, etc. They were pleased with his answers, and said, "Indeed, we should have lost a great treasure had we put this man to death, as we have so often been on the point of doing."

Thus the time passed on till spring, but for Father Jogues the prospect of death was never remote. Whenever any of their "braves" fell in their numerous expeditions, he was liable to be demanded as a victim to be offered up in compensation.

His feelings were harrowed from time to time by seeing the awful tortures inflicted on Indian prisoners from other tribes when they were brought into the village. Burning alive was one of the most merciful of these. On one occasion he baptized a woman at the stake while raising a drink of water to her parched lips. As she was burnt an old Indian exclaimed, "Demon Areskoi, we offer thee this victim whom we burn for thee, that thou mayest be filled with her flesh, and render us ever anew victorious over our enemies."

HE PLANS AN ESCAPE

In the summer he was sent with a party of Indians on a fishing expedition. Hearing, however, that some captive Hurons had been brought to the village during his absence, he begged for leave to return that he might have the opportunity of instructing them. This was granted, but on his way thither, stopping at Fort Orange, a Dutch settlement (now Albany), he heard that the Indians in the village were extremely incensed against him, and had positively determined on his death.

The commander of the Dutch troops, when Jogues arrived there on his way back to the village, offered him the means of escape. "Here," he said, "lies a vessel at anchor ready to sail in a few days. Get privately on board. It is bound first to Virginia, whence it will carry you to Bordeaux or Rochelle." Thanking him with much respect, Father Jogues told him that the Indians would suspect the Dutch of favoring his escape and perhaps do them some injury. "No, no!" he replied, "do not fear, get on board; it is a fine opportunity, and you will never find a surer way of escaping."

After long consideration, the Father saw the reasonableness of the commander's advice. It became clear to him that the danger from the hostile Iroquois was too great, and the likelihood of his being able to help the captive Hurons too slight, to make it wise for him to remain. He made up his mind to go.

In the evening, before lying down, he went out to see the way by which he could most easily escape. Unfortunately, one of the dogs which were let loose at night snapped at his bare legs and bit one severely. He immediately reëntered the barn, and the Iroquois, whose suspicions had been aroused, closed the door securely, and, to guard him better, came and lay down beside him.

The whole night he spent without sleep. Towards dawn he heard the cocks crow, and soon after a servant of the Dutch farmer to whom the barn belonged entered by another door which had been left unguarded. Father Jogues went up to him softly, and, not understanding Dutch, made him a sign to stop the dogs barking; he immediately went out and Father Jogues followed him.

Having got out of the barn without making any noise or waking the guards, he climbed over a fence which inclosed the barn, and ran straight to the river where the ship was. It was as much as he could do with his wounded leg, for the distance was nearly a mile. He found the boat as he had been told, but since the tide had gone down it was high and dry. It was an anxious moment, as the sun was rising and the Iroquois might at any instant discover his escape. He called to the ship for a boat to be sent to take him on board, but receiving no answer redoubled his exertions to push the stranded boat to the

water. To his surprise he at last succeeded, and jumping in reached the vessel unperceived by the Iroquois.

He was immediately lodged in the bottom of the hold, and to hide him they put a large box on the hatch. Here he spent two days and two nights, half regretting his escape from the Iroquois, as he was nearly suffocated by the stench.

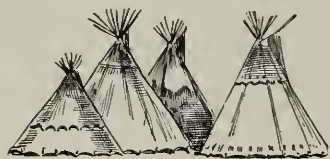
Presently the Indians came out to the ship and with loud threats demanded to have him given up. This the officers refused to do, but at night sent Father Jogues to the Fort, where he was housed in the dwelling of a miserly old man who appropriated half the food that was sent him. The garret where Father Jogues lay in hiding was divided only by a thin partition from the room where the old man, who was a trader, trafficked with the Iroquois, who came to him. This partition had many crevices, and, had any curious savage applied his eye to one of them, the escaped prisoner might have been detected. Accordingly, whenever he heard them coming, he crouched down in the remotest corner.

The angry Iroquois were at last appeased by the Dutch with an offer of about one hundred pieces of gold. Father Jogues was sent to New Amsterdam, where he was kindly received and clothed by Director Kieft, who gave him a passage to Holland in a vessel which sailed shortly after. But his misfortunes were not yet ended. The vessel was driven in a storm on to the English coast near Falmouth, where it was seized by wreckers, who stripped Father Jogues and his companions of nearly all their clothes and left them to pursue their journey as best they could. Falling in with the crew of a French ship then in the harbor, he obtained a passage to France, which he reached on Christmas Day, 1643.

A merchant took him to Rennes, and he presented himself at the college of his order as one who brought news from Canada. The rector hurried to see the stranger as soon as he heard the word "Canada." Almost his first question was, "Do you know Father Jogues?" "I know him well," said the other. "We have heard of his capture by the Iroquois, and his horrible sufferings. What has become of him? Is he still alive?" "He is alive," said Father Jogues, "he is free, he is now speaking to you," and he cast himself at the feet of his astonished superior to ask his blessing.

HE RETURNS TO CANADA AND IS SLAIN

Father Jogues, however, felt irresistibly impelled to return to Canada, and having obtained permission from his superiors he arrived there in the spring of 1644. Soon after his arrival he was commissioned by the Governor to proceed to the Mohawks to congratulate that tribe on the conclusion of a recently negotiated treaty. In writing to a friend just before he set out, he used the fateful words, "Ibo et non redibo," "I shall go and shall not return." He set out in company with some Indians for the scene of his former sufferings. Passing through Fort Orange he proceeded to Oneugiourne, one of the Mohawk villages. Presents were here exchanged in ratification of the peace; the French received every assurance of future welcome, and passed on. Unfortunately, Father Jogues left with his Indian hosts a small box containing some necessaries as a guarantee for his return. Sickness, however, broke out during his absence, and worms destroyed their harvest. They now became convinced that he had left the Evil One in that box, and on his reappearance among them they stripped him of his clothing and beat him with heavy clubs. As he was entering a wigwam he was treacherously felled with an ax, his head was cut off and stuck on the palisades, and his body flung into the river.



A THOUSAND-MILE RACE WITH HOSTILE INDIANS

HOW YOUNG GEORGE WASHINGTON WON HIS FIRST RENOWN

GOVERNOR DINWIDDIE of Virginia, having decided to send a remonstrance to the French, who were so rapidly pushing their line of forts up the Ohio valley, cast about for a suitable person to bear his dispatches. But

WASHINGTON ON HIS MISSION INTO THE OHIO VALLEY

the lateness of the season added so much to the extreme hazard of the expedition that the regular scouts shrank from the undertaking. At this point the governor, feeling the necessity of haste, offered the commission to George Washington, then a youth of twenty-one years, and Washington promptly accepted the dangerous duty.

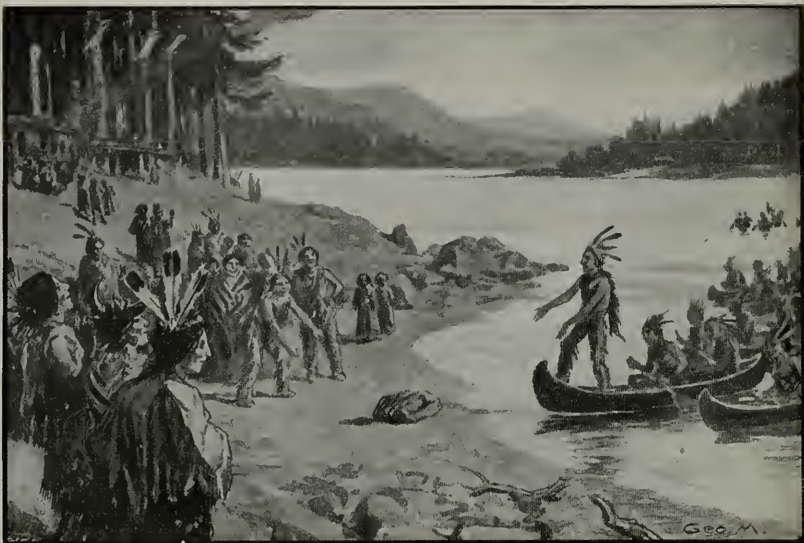
Having safely delivered his message to the French commander and received his answer, Washington began his return journey with winter fast closing in upon him and with the knowledge that his trail was being watched by treacherous foes and hired Indian assassins. In order to make better time, he set out with only one white companion and an Indian guide. This guide, however, was himself in the pay of the French. He exerted himself by every species of craft and savage cunning to get possession of Washington's gun. Failing in this, he increased his pace, hoping so to wear the white men that at nightfall they would become an easy prey. But the men he was guiding were of too tough a fiber to be thus exhausted. At last, wearying of artifice, the Indian turned upon them suddenly and fired at Washington with his rifle at a distance of a

few feet. He was unsuccessful in injuring either man, but largely through Washington's generosity made his escape into the darkness of the forest. The travelers were now without a guide and certain of pursuit.

They continued their journey all that night, nor did they stop until they reached the banks of the Allegheny. This they had hoped to find sufficiently frozen to allow of a ready passage, for the cold was intense. But the rapid stream was still unfrozen, although fringed with ice and full of floating cakes. With a single hatchet they set to work to make some kind of a raft that might support them, and fastening together a few logs, they pushed out into the current. Unable to manage the raft in the floating ice, and Washington having been thrown into the water, both men were forced at last to abandon it, and attempt to swim to the opposite shore. They managed to reach an island in midstream and there passed the night, which was so cold that both the hands and feet of Washington's hardy backwoods companion were frozen; but the robust strength of the young Virginian resisted the severe exposure to which he was subjected. Fortunately during the night the portion of the river between them and the farther shore froze sufficiently to bear their weight, and it is by this circumstance that Washington's life was saved for his great future work.

Upon his safe return after a journey of more than a thousand miles on foot in the winter cold through a hostile wilderness, constantly pursued by Indian spies, Governor Dinwiddie sent a report to England, and this report being published in London gave to Washington his first general renown.

THE CROSSING OF THE ALLEGHENY RIVER



BARGAINING FOR A BRIDE, IN THE DAYS BEFORE THE WHITE MAN CAME

FRIEND OR FOE?

CAPTAIN BENJAMIN CHURCH'S DEATH STRUGGLE WITH THE MOHAWK

AMONG the hardy defenders of the Plymouth Colony at the time of King Philip's War, was a Captain Benjamin Church, whose activity and courage brought him many thrilling adventures and hair-breadth escapes. Indeed, it is doubtful if any man ever faced death more frequently or more near at hand than this sturdy Pilgrim Father. One of his experiences is thus narrated by his son:

"Mr. Church was moved with other wounded men (he had been wounded in a battle with Indians a few days before, being struck by three bullets) over to Rhodeisland, where in about three months' time he was in some good measure recovered. . . . But the general's great importunity again persuaded him to accompany him in a long march into the Nipmuck country, though he had then tents in his wounds, and was so lame as not to be able to mount his horse without two men's assistance.

"In this march the first thing remarkable was their coming upon an Indian town where there were many wigwams in sight; but an icy swamp, lying between, prevented their running at once upon it. There was much firing upon each side, but at length the enemy all fled, and a certain Mohegan, that was a friendly Indian, pursued and seized one of the enemy that had a small wound in his leg, and brought him before the general, where he was examined. Some were for torturing him to bring him to a more ample confession, but Mr. Church interceded and prevailed for his escaping torture. But the army being bound forward in their march, and the Indian's wound somewhat disenabling them, it was concluded that he should be knocked on the head. Accordingly he was brought before the fire and the Mohegan that took him was allowed to do the bloody deed. Mr. Church taking no delight in the sport, framed an errand at some distance among the baggage and horses. When he had got ten rods, or thereabouts, from the fire, the executioner, fetching a blow with a hatchet at the head of

the prisoner, missed his stroke, and the hatchet flew out of his hand. The prisoner, in the confusion, broke from those that held him and, notwithstanding his wound, made good use of his legs, and happened to run right upon Mr. Church. A close scuffle followed, but the Indian, having on no clothes, slipped from him and ran again. Mr. Church pursued him, although, he also being lame, there were no great odds in the race, until the Indian stumbled and fell; and then they closed again, scuffled, and fought, until the Indian, by the advantage of his nakedness, again slipped from his hold and set out upon his third race. And running through a swamp that was covered with hollow ice, they made so loud a noise that, in spite of the intense darkness, Mr. Church hoped (but in vain) that some of his friends would come to his assistance. In the heat of the following struggle they heard the ice break with somebody coming apace to them, which, when they heard, each knew that help was coming for one or the other, but which should receive the fatal stroke could not be told. Without speaking a word the newcomer came upon them. In absolute silence he felt out the two combatants, the one naked and the other clothed. Then he felt where Mr. Church's hands were fastened into the Indian's hair, and with one blow settled his hatchet between them. He then spoke to Mr. Church and hugged him and thanked him for catching his prisoner, for it was none other than the Mohegan who had first captured the desperate runaway."

CAPTAIN BRADY'S ESCAPE

HOW AN INDIAN BABY SAVED THE BOLD FRONTIERSMAN

CAPTAIN SAMUEL BRADY was one of that band of brave men who, in the trying days of the Revolutionary War, lived on the western borders of Pennsylvania, exposed to all the horrors and dangers of Indian warfare. He held a commission from the Continental Congress, and took a leading part in the local military activities. Many incidents are related of his coolness and presence of mind as well as of his great strength and prowess.

In one of his adventurous excursions to the Beaver or Mahoning River, it so happened that Indians surprised him in his camp and took him prisoner. To have shot or tomahawked him on the spot would have been but a small gratification to that of satisfying their revenge by burning him at a slow fire after having run the gantlet in the presence of all of the Indians of their village. He was therefore taken to their encampment on the right bank of the Beaver, about two miles from its mouth. After the usual exultations and rejoicings over the capture of a noted enemy, and the ceremony of the gantlet, a fire was prepared by which Brady was placed, stripped of his clothing but unbound. Around him the Indians formed a close circle of men, women, and children, dancing, yelling, and uttering every manner of threat and insult which their invention could devise. Brady looked upon these preparations for his death with a firm countenance and a steady eye, meeting all their threats with a fortitude equal to their own.

In the midst of their baiting, the squaw of one of their chiefs came near him to heap upon him some new opprobrium. In her arms she bore a young child. Instantly Brady perceived that the opportunity for which he had been watching intently was thus placed in his way. Quick as thought he snatched the child from the woman's arms and dashed it into the fire. A cry of rage and horror rose from the Indians, who with one impulse rushed forward to save the infant son of their chief from the flames by which he was surrounded. In the midst of this confusion Brady darted from the circle, overturning all that came in his way, and rushed into the adjoining thickets with the Indians yelling at his heels. Not less than fifty rifles sought his life, but so rapid was his course, and so expert had he become in the arts of border warfare, that he was not even wounded, but made good his escape. He had then to traverse more than a hundred miles of forest, naked and unarmed and suffering from his experience at the terrible gantlet. But such was his hardihood that he reached his own cabin apparently but little the worse for his experience. He lived many years after, a terror to the hostile Indians who preyed on the infant settlements of the Ohio valley.

LEWIS AND CLARK

THE COLORADO DESERT

IN the days before railways the States or Territories of Colorado and Wyoming came to a great extent under the head of *les mauvaises terres* of the old *voyageurs* — lands, that is, that would never repay the labor spent on their cultivation; and even in these times of steam-plowing and scientific irrigation many hundreds of square miles remain bleak stone desert and ill-watered prairie.

When the Lewis and Clark expedition set out from St. Charles in 1804 to discover the sources of the Missouri River, these lands were "bad" in a more alarming sense than that of barrenness, for they were the homes, if not the exclusive property, of fierce Indian tribes who regarded the white man as their natural enemy, and whose treatment of him if he fell into their hands was by no means limited to mere robbery.

Captains Clark and Lewis were officers of the United States Army, and by virtue of military experience, scientific knowledge, and familiarity with Indian customs and dialects, were remarkably well fitted for control of the perilous march from Kentucky, across the northern continent, to the Pacific shores.

The early days of the journey were far from being unpleasant or arduous. The weather was fine, without excess of heat or cold; the route never lay very far from the river, and the few Indians encountered were either too friendly or too timorous to be regarded as a cause of anxiety. But when a halt was made at the Platte River everyone felt that the days of security and of fatness were drawing to a close. On both banks lay hundreds of thousands of acres of cheerless prairie, offering nothing more in the way of food than buffalo meat. Other animals were in evidence; elks and deer, which were unassailable while they protected themselves behind impenetrable herds of bisons; wolves and bears, the latter having a habit of reconnoitering the camp from a short distance, as though one of them meditated a descent on it at a convenient season.

Still, there was no further sign of Indians, and the nearer approach of some of the buffaloes (or, strictly speaking, bisons) constituting a temptation to the marksmen of the party, Captain Lewis prolonged the halt for a day while an old French hunter and his son, who had voluntarily accompanied the expedition, went in search of game.

As by noon they did not return, Lewis remarked to some of the men who were unoccupied:

"Some of you fellows had better rig up a wagon and stand by to — What was that?"

"And that? And that?" added Captain Clark, who had joined the group. "One barrel from one man, and two from another immediately after. Do they think they're bagging partridges?"

Before the question could be satisfactorily answered three more reports in rapid succession were heard.

"I don't like it," said Lewis, unslinging his telescope. "What arms had the Frenchmen?"

A soldier replied:

"Two double-barreled guns each, sir, and most likely their pistols."

"They 're not the men to waste ammunition for the fun of the thing," said Clark, while his friend scanned the landscape through his glass. "And neither of them is the man to want two shots at a bison."

He turned to go in search of his own telescope, when a loud exclamation from Lewis pulled him up short.

"Well?" he asked. "Indians, I reckon."

For answer Captain Lewis held out his glass.

"Have a look," he said, and, turning to the sergeant of the guard, continued abruptly, "Fall them in — open order — ball cartridge — prepare to receive —"

"Buffaloes!" ejaculated Clark, finishing the order, but in a hoarse and awestruck voice that belied his apparent levity.

What had at first been only visible through a telescope was now to be seen with the naked eye. Less than a thousand yards away were two men riding madly across the desert towards the camp, and close behind them a reddish-black mass that could only be a bison herd; and, as the distance lessened, a couple of puffs of white smoke, followed presently by two little pops, showed that the riders were reduced to their pistols for means of defense.

"If they 'll only have the sense to lead the brutes off the track a bit we can get in a safe volley at long range, and have another ready for them if they care to come so far," muttered Lewis to his companion.

A TRAIL IN A WESTERN CAÑON

This was true enough, but then the bisons could not be expected to advance in conformity with drill-book regulations, nor was it at all certain that the hunted men's self-saving instinct would not lead them blindly towards the tents, thus making it impossible for their friends to fire without risk of shooting them instead of their pursuers.

The sound of hoofs thundered and vibrated across the desert, and the watchers seemed to hear the infuriated snorts of the herd and the panting of the frightened horses. Another uncomfortable doubt arose in the minds of the two officers: Would the Frenchmen keep together, or would they, more wisely, separate?

As though desirous of curtailing the watchers' anxiety, one horseman suddenly wheeled slightly to the left, and the other to the right, and in a few seconds they were several yards apart.

"Bravo!" cried Lewis. "Now *we* get a show."

The buffaloes, mystified at the dividing of the foe, half stopped, hesitated, then came on again with increased speed — tails high in air, noses to the ground, and manes bristling with fury.

"Present!" The order came the moment the fugitives were far enough apart to be out of the firing-line. The soldiers breathed hard through clinched teeth; a cavalry charge would be sport to this. Their bayonets or gun-butts would at least have been of some use to them. "Fire!"

A rattling report rang out across the plain, reëchoing down the steep river-banks, and a cloud of smoke hid the opposing forces from

each other till muskets were reloaded. The cloud drifted, and showed the enemy to be diminished by the flight of about ninety per cent of them; a dozen or more animals lay dead or dying, and the remaining few had halted, and were either sniffing at their fallen brethren or gazing with wonder on their assailants, and, when the men were ordered to advance at a slow double, these also turned and fled.

The hunters now rode up, and, when they had regained their breath, told their story. They had surprised a group of young bisons a couple of hundred yards away from the herd, and had shot two of them, the rest fleeing; and, emboldened by success, they had drawn nearer to the herd, killing one of the number at long range. Then the whole herd had unexpectedly rushed upon them.

The explorers had still not seen the last of the bisons, for on the next day, as they came to a deserted Indian village, they beheld on one side of it a sight quite novel to all but the two hunters. Hundreds, if not thousands, of these prairie oxen were gathering together in a rough circle, and the old bulls seemed to be driving the cows and calves into the center, themselves forming the circumference of the ring.

The old French hunter, after watching these movements with intense interest, said suddenly and laconically, "Wolves! They smell them!" and, while he yet spoke, one of the soldiers, with an exclamation of surprise, pointed up the hill beyond the herd, down which rushed a pack of wolves almost as numerous as the bisons. Lewis called a halt, and warned the men to be on their guard.

"The bisons have given us meat for some time to come," he said. "We 'll stand by them if need be."

The hungry pack swept down the incline, one enormous heaving billow, trampling down those that were slow of foot, each trying to outstrip or overleap the other in their lust for prey. As the harsh cries grew nearer, the bisons were seen to have completed their plans for defense, and the army of wolves found a truly fearful array of horns and heads like battering-rams awaiting their attack.

The onlookers stood a-tiptoe in tense anticipation and wonderment, silent witnesses of one of those conflicts by means of which Nature so wonderfully provides against surplus population among the lower animals.

A discordant intermingling of lowing and howling, followed by spasmodic barks, gasps, snorts, and yelps, announced that the battle had begun. The wolves, repulsed at one quarter, sought another, and a young male bison with a deep groan of agony fell on his knees, a huge gray wolf hanging by his teeth to the poor creature's neck. But the wolf's triumph was of short duration, for the magnificent bull that stood next, with a sideward lunge of his head, sent him flying through space like a stone from a catapult; then turned to meet a double assault, and immediately one enemy lay gored from back to front, while the other, which had sprung at the hero's throat, was crushed and writhing beneath the bison's fore feet. Then the long-restrained excitement of the soldiers burst forth in a hearty cheer, at the sound of which many of the wolves fled, and the bisons looked wonderingly around as though expecting a new foe.

But now a detachment of thirty of the attacking force made combined assault at a small breach left by the fall of some of the defenders, and with triumphant barks began slowly to make their way inward.

Captain Clark turned to his colleague, and said in a sickened whisper:

"I can't stand any more of this. Let 's give these fiends a shot or two."

"Yes; I allow we 've had about enough of it," replied Lewis, wincing involuntarily as the bull that had so distinguished himself was pulled down by four wolves.

A few well-judged shots brought about a cessation of hostilities, during which some of the famished wolves began an informal meal, apparently indifferent as to whether the subject thereof was bison or brother. Another small volley, accompanied by the waving of extemporized flambeaux of dry brushwood, sent the loathly pack tearing up the hill again, while the bisons galloped contentedly away in the opposite direction, ignoring their allies.

The expedition moved forward again, and at night encamped near a bend of the river. Just as the evening meal was finished, half a dozen Indians suddenly appeared, and, challenged

BISON ATTACKED BY WOLVES

by the sentries, civilly asked for the paleface chief. After an exchange of courtesies they said that their camp was a mile away, and that, on hearing through scouts of the approach of the white men, the chiefs had sent to invite them to a council to be held on the morrow to decide about going to war with a wandering western tribe.

Following their usual policy of conciliating the natives when possible, the explorers willingly agreed to attend, and dismissed the ambassadors with a package of tobacco. In the morning it appeared that the Indians had decided to come and hold their conference in the visitors' camp, for just as the guard — twenty soldiers, Clark's negro servant, and the two Frenchmen — turned out to escort the officers, mount guard over the camp, or reconnoiter the neighborhood, a large body of braves, unarmed, were seen riding towards the tents. Lewis ordered the firing of a blank volley in salute (and possibly as a hint against treachery), and then had the wagon awnings and sails of the portable boats rigged into a commodious canopy for the speech-makers to sit under.

The senior chief opened with a few words of welcome and called upon the white men — whom he christened the "great medicine"— to give their views as to what treatment should be meted out to a tribe that had stolen their cattle and one of their women, and had tried to slay some of the braves.

Lewis understood the Indian tongue better than he spoke it, and began a halting and somewhat rambling speech, the purport of which was to advise the savages to avoid war and live peaceably. But, before he could finish, one of the chiefs rose impatiently, and exclaimed that there had been enough talk, and that, while they were conferring, the Shoshonees, or some other evil-disposed tribe, might be ravaging their camp. Immediately the other chiefs rose, not to depart, but to express their wrath and horror at this breach of politeness, and the restless one sat down, abused and abashed.

But the council was fated not to reach a formal conclusion, for presently shouts of alarm sounded from the Indian village; there was a confused champing and whinnying of tethered horses, followed by a stampede of bisons, with small herds of deer and a few agitated

pelicans; then the unmistakable reek of burning vegetable matter. The prairie was on fire.

The explorers' camp could take no harm, for there was nothing more inflammable than sand and short grass within several yards; but, judging from the trepidation of the redskins, it was probable that theirs did not enjoy like security. There was a general rush for the native camp, and before the officers could reach it the flames were driven back from all the wigwams save two or three that were more or less isolated. Soldiers and Indians united in trying to save the luckless occupants, two of whom were burned to death before help could reach them; for the flare of a burning prairie is like a live thing that darts at a man before he can move, and shrivels him like a moth in a candle-flame.

All others were safe now, except a half-caste lad and his mother. The boy was paralyzed with terror, and lay huddled, neck and heels, deaf to the frantic woman's appeals. Three times she tried to lift him, but could not, and the flames were now within a few yards of her, and before the rescue party could reach her she must perish. The palefaces turned their heads away, for they had not learned to look unmoved on such sights. But a minute afterwards triumphant cries from the Indians proclaimed that something unusual had happened, and, upon looking round, the soldiers caught sight of the woman running well ahead of the flames towards a bare hillock, where no hurt could touch her; and, as the fire rushed on past where she had stood, a dark mass rose up from the ground, and the halfbreed boy began to walk uninjured towards the wigwams. The quick-witted mother, as a last resource, had wrapped the boy in a wet buffalo-hide, and the fire had passed him over, leaving him unscathed.

Before Lewis and Clark could express their admiration, some Indians came up to them and thanked them warmly for having extended their protection to the boy, explaining that he was the son of a white man, and that he had been saved by the presence of the "great medicine."

The warm weather was now ending, and the expedition, dreading a winter in the desert, hastened onward, leaving the Indians to settle their disputes as they might. The meat-supply was growing short, and there would be little more chance of bison-beef, for already the herds were beginning to move southward, as they always do when autumn comes on. A beautiful and unlooked-for phenomenon gave warning of the coming cold weather. One night Lewis was aroused by the sergeant, who stood pale and perturbed looking at his captain's tent-door. He was from the South, and knew not winter as it is understood in Colorado and Wyoming. He pleaded so urgently that the captain should "come outside and look" that the latter followed the disturber of his slumbers to the door, only to find that the Southerner had been scared out of his wits by a very fine aurora borealis, a description of which may well be given in Lewis's own words:

"Along the northern sky was a large space occupied by a light of a pale but brilliant white, which, rising from the horizon, extended itself to nearly twenty degrees above it. After glittering for some time, its colors would be overcast and almost obscured, but again it would burst out with renewed beauty; the uniform color was pale light, but its shapes were various and fantastic. At times the sky was lined with light-colored streaks, rising perpendicularly from the horizon, and gradually expanding into a body of light in which we could trace the floating columns sometimes advancing, sometimes retreating, and shaping into infinite forms the space in which they moved."

This, as the explorers had feared, proved a harbinger of severe weather; in a few more days the ground was iron-hard, and in less than a fortnight the thermometer sank to twelve degrees below zero, and eventually as low as thirty-two degrees. Before the winter was over, the sufferings of the travelers were indescribable, and it says much for the tact and kind firmness of the two officers that there was never any threatening of mutiny — a trouble that has only too often beset the explorer. Every ounce of meat had to be grudgingly weighed out; the attacks of wolves must be warded off, frequently with much expenditure of ammunition that could ill be spared, and at length, when the last of the salted meat had been consumed, horses had to be slaughtered for food. Moreover, the only drink obtainable was melted snow.

But spring came at last, the thaws set in, and

TOP: THE GREAT BUTTE ON THE COLORADO RIVER. BOTTOM: THE FAMOUS MOUNTAIN OF THE HOLY CROSS, IN THE ROCKY MOUNTAINS, THE CROSS BEING FORMED BY THE GREAT GULCHES FILLED WITH SNOW AND ICE. THIS IS VISIBLE FOR A GREAT DISTANCE.

the desert became a swamp. Then came a strong wind from the north, which converted swamp into sand, and also inflicted a new torture on the soldiers, every one of whom was soon on the sick list from soreness of the eyes arising from the sand-clouds. Captain Lewis observes:

"The particles of this sand are so fine and light that it floats for miles in the air like a column of thick smoke, and is so penetrating that nothing can be kept free from it, and we were compelled to eat, drink, and breathe it very copiously."

As they bent their course farther to the northwest they found the ground so rugged and broken that quick traveling was an impossibility, and to this succeeded, first, bare, burnt-looking hills, and then a salt desert, where were banks and sand-bars incrusted with salt as it were frost.

The early summer was marked by an event of signal importance to the explorers — the discovery of the Missouri Rapids.

On the first night spent by the river some Shoshonee Indians were seen paddling across from the opposite bank. Lewis and Clark received them with due civility, gave them a seat at the campfire, and invited them to smoke with them. They did, and profited by the occasion to steal a pipe and an overcoat, and, when charged by one of the soldiers with the theft, moved sulkily down the bank to their canoe.

"We 've not seen the last of those amiable beings," said Clark, when the officers were alone in their tent. "They were spies; I watched 'em."

Lewis answered slowly:

"I 've given them the credit of being so, at any rate, and I 've posted extra sentries, and served out ball cartridge with a pretty lavish hand." Lewis had ever treated the natives with infinite forbearance, but his patience was nearing its end.

Suddenly a strong wind rose, and before long the rain was falling in sheets. The two captains were disinclined for sleep, knowing that, if the Indians dared face such a storm, it was the kind of night they were most likely to choose, either for petty camp robbery or for a planned general assault. Therefore they were in no way surprised when, as the rain abated after a continuous downpour of three hours, they heard a gunshot from one of the sentries.

"As we thought!" said Clark, as the two buckled on swords and examined pistols. Before they could get out of the tent, other shots were heard, followed by the voice of the sergeant mustering the guard.

"Thieves! I 've shot one! After the guns!" said the old Frenchman at sight of the officers.

"Away from the fire!" shouted Clark. "Don't show them light to kill you by." As he spoke an arrow whizzed through the flare of the watch-fire, and passed so near to him that the plume brushed his cheek. It was a time for the defenders to walk warily; the movements behind the wagons told that the camp was surrounded — at least by inquirers, if not by enemies — while a couple of dead Indians near the fire, one still holding a rifle, the other a pistol, both the property of the camp, were evidence that a skillfully planned seizure of the white men's arms had been attempted.

"Ah! Would you?" It was Lewis's voice, and as he spoke he stooped and seemed to snatch at something, then sprang upright again, dragging with him the lithe body of an Indian who had been crawling, wormlike, from near the captain's tent, and who, seeing it was impossible to escape, now wound his arms and legs round the white man in a close, almost serpentine hold. But his grip was puny beside that of the burly American, who without apparent effort suddenly shook his assailant to the ground, where he lay with a couple of ribs broken.

Clark's caution to the men to keep out of the firelight had come none too soon, for as his friend freed himself from the Indian a flight of arrows from the river side of the camp whizzed through the air, and a groan from one of the soldiers showed that all had not missed their mark. A rapid order was given, and in a short time a dozen of the defenders were outside the camp, and fifty Indians were hemmed between the two little forces.

"Butt-ends! Save your powder!" cried Lewis. The savages, unable now to use their bows to much advantage, fell back on their war-hatchets, but these were of little use against

butted muskets or the skillfully handled swords of the two officers. The Indians had begun to despair of help from allies who had either stayed away or had fled, and now endeavored to force a way through the gaps in the two sparse lines. They disliked the situation greatly, and wished they had not come, for these palefaces were hard men, who fought coolly and in dead silence, who were no whit frightened at their war-cries and antics, and who obeyed with, to them, inconceivable regularity the commands of the two terrible chiefs whose swords were playing such havoc among them.

One of the more intrepid aimed a blow with his tomahawk at Captain Clark, which was parried, and, the instant after, two others, armed with knives, made a dash at the swordsman. One reeled backward on to the hot wood ashes, felled by a blow on the face from Clark's hilt, and the other was shot through the head by the captain's black servant.

The Indians set up a despairing howl; this was not their style of fighting. Instead of surrounding they were the surrounded, and here were no convenient trees or bushes from behind which they could shoot at their ease. The howl waxed louder, and the attempts at flight more desperate, till at length all who could move had made their escape at weak points, and fled across the desert or into the water.

"I don't think those individuals will call again," remarked Lewis, as he bound up a knife-cut in his brother officer's arm.

Nor did they; and once across the mountains, and arrived at a spot where reënforcements and supplies awaited the expedition, further danger from bisons, famine, or unfriendly Indians was at an end.

When the explorers reached the upper waters of the Columbia River, they voyaged down this great stream in boats and canoes, although a number of accidents occurred along the way. The following winter was spent in a rough fort which members of the party built near the coast of the Pacific Ocean. Both Lewis and Clark faithfully recorded the various happenings in their journals, and these works make highly interesting reading.

DAKOTAH INDIANS PLAYING BALL OR LACROSSE, AS SEEN BY LEWIS AND CLARK

THE PERILS OF WHALE HUNTING

WHALE hunting, for the valuable oil extracted from the blubber, was, not many years ago, an important industry. Many ships were fitted out every year for this dangerous work, and, although the business is now practically at an end, there are many stories told in the old whaling towns of adventures with the monsters of the sea.

HOW A WHALER ESCAPED FROM A WHALE'S JAWS

Franklin Atkins of Provincetown, Massachusetts, used to say that he and Jonah were the only two men who had ever been in a whale's mouth and come out alive. The bold sailor's remarkable experience happened in this way:

Atkins was a member of a crew engaged in whaling in the waters of the West Indies. A large sperm whale had been sighted and a boat sent in pursuit, after the manner of hunting the great fish. A boat would endeavor to draw near enough to the unsuspicious victim for a man standing in the bow to fasten a harpoon in him. To this harpoon was attached a long rope by which the boat was drawn after the animal as he attempted to escape. When the whale wearied, as he must, he would allow of an approach near enough to enable the spearman to strike him a death-blow with a lance. Immediately after the harpoon was lodged in the animal's tough hide, and while the boat was being dragged along at a furious speed, accidents were very likely to occur. The first movement of the whale is to dive, or "sound," as it is called, to a great depth. The rope attached to the harpoon would then run out with such speed as to smoke with the heat of friction. Suddenly this would stop. The rope would slacken, followed by a time of suspense and anxiety. Having reached his depth, the wounded animal was certain to rise, sometimes directly under the boat, which would be dashed to pieces.

The whale struck by the crew of Atkins' boat was of a dangerous kind. He was a lonely sperm bull, a variety very likely to put up a fight for his life. As soon as the harpoon had been fastened in his side, instead of sounding, as was expected, he turned upon his enemies and charged. In vain did they back water in a desperate attempt to avoid the blow. The boat was struck with terrific force squarely amidships and hurled completely out of the water and broken in two. The men were scattered in all directions. Atkins was thrown several yards straight up into the air, and when he descended he fell straight into the jaws of the monster. The sperm whale has large and pointed teeth of very hard ivory, and Atkins was terribly hurt by the points upon which he fell. He was at first dazed, but in an instant came to his senses. A fraction of a second in such a position is sufficient for many thoughts, and seems like a long period of time. Atkins felt certain that the animal would sound and carry him to the bottom of the ocean and back. He began to wonder if he could possibly survive such an experience. Then he realized that it was darkening. The huge jaws were coming together. This brought him to his senses, and with all his strength he grasped a huge, white tooth, and swung himself up and clear of the descending jaw. He heard it snap behind him. Then the monster sounded. Another boat from the ship was already racing to their relief and Atkins was dragged out of the water terribly bruised and wounded. The whale was afterward captured, and more than a hundred barrels of oil taken from him.

THE STRUGGLE WITH THE TERROR OF WHALERS

One old sperm whale became so well known and had destroyed so many boats and been the cause of so much loss of life that the hunters had given him the name of "Moby Dick," and shunned his feeding ground, which was in a certain stretch of water to the west of South America. One old whaling captain, who had suffered much at his hands, nursed his wrath for many years. When the exploding harpoon was invented, he felt that he had a weapon with which he could safely attack even Moby Dick. So he turned his vessel, on his very next cruise, to the much feared locality.

After cruising about for some days, the lookout at the mast head gave the familiar shout, "There she blows!" To this the in-

WHALE READY FOR FLESHING

variable answer is, "Where away?" The answer that came back this time was "Broad on the lee bows!" Two boats were quickly lowered, one under the command of the captain himself, the other in charge of his mate. As they drew near, it became apparent that they were indeed about to attack the dreaded monster. His huge bulk lazily rolled on the water as he turned towards them and coolly awaited their coming. That was Moby Dick's way. Whales as a rule sounded at the first suspicion of a pursuit. Cautiously they approached the cunning monster, which made no move to prevent them. He neither sought to avoid, nor winced at the stroke of the harpoons which were fastened in him, although, from many past experiences, he must have had some idea of what to expect. But the instant that he was struck, when the boat was in the most helpless position, he dashed towards it. The mate, however, who had been previously instructed by the captain, at this point sent a second harpoon into his sides. The animal, confused by this fresh attack, turned on his new assailant. As he did so, the captain's boat again took up the battle, and again turned the whale. At this point the animal sounded, with the evident intention of demolishing them from beneath. Both boats rushed for the protection of the ship, which was slowly sailing towards them. But Moby Dick had miscalculated this time. Exploding harpoons were something new in his experience, and, when he rose, it was with the weariness of death already upon him. He was quickly dispatched. In cutting him up, the irons of twenty-three harpoons, each bearing a different ship's name, were found imbedded in his flesh.

For accomplishing his death, the captain had no other reward than the satisfaction it may have given him, for the whale proved to be a "dry-skin," that is, without oil-giving blubber.

THE RESULT OF AN EXPLOSION IN THE POWDER MAGAZINE

FIGHTING UNDER ADMIRAL FOOTE

AT the very beginning of the war the Southern Confederacy laid the keels of four powerful men-of-war for use on the Mississippi River. These were one by one destroyed. Thereupon the Citizens' Defense Association of New Orleans seized ocean steamers, gulf towboats, and whatever else they could, in an effort to create a new Confederate navy on the inland waters. These boats relied principally on their power and speed, in which they were vastly superior to the Union squadron of ironclads on the Mississippi. The Southern vessels were fitted with powerful rams, but had little in the way of guns.

The Union boats were so awkward and slow that the great Admiral Farragut used to say that he preferred "wooden boats, but iron men."

These first ironclads were gotten up by General Fremont, General Halleck, Mr. James B. Eads, an engineer, and Assistant Secretary Fox of the United States Navy. None of these men knew anything about shipbuilding, and the results of their efforts were astonishing, to say the least. These boats could go anywhere the current went — and the current is swift in the Mississippi. The racer of the fleet, in an exciting struggle, made two miles an hour upstream, and then tied up to the bank for the "slow" members of the fleet to catch up with her! This squadron gave the first battle in the world's history with ironclads. All the great nations of Europe had representatives on the spot studying the results.

The ships purchased, seized, and refitted by the Confederate Citizens' Defense Association had cost them nearly two millions of dollars. This sum the Confederate government agreed to repay provided they should succeed in fighting the Federal fleet above Memphis. The following incident occurred during the struggle to accomplish this object. The description is by one of the actors in the fight.

WHAT A BOY SAW ON THE MISSISSIPPI

"While we had the greatest weight of metal, they had the advantage in every other particular," writes Mr. Eliot Callender. "Not one of our boats could back upstream. They were not built that way! The enemy were fighting upstream with powerful and easily handled boats, while we were fighting downstream with boats that could not be handled at all. If one of his boats was disabled, it drifted downstream into the hands of friends. But if one of our boats was crippled it was carried by the same current where there was 'no one to love, no one to cherish,' but where speedy connections were made with the bottom of the river or with Andersonville Prison.

"The Federal fleet lay at anchor five miles above Fort Pillow, awaiting a movement of the army. But in order that the Southerners might not forget us, a mortar-boat, throwing a shell thirty-nine inches in circumference, was made fast to the shore just above a point behind which the fort lay, and every half-hour during the day one of these shells would climb a mile or two into the air, look around a bit,

and descend and burst in the vicinity of the fort. It kept the garrison interested, to say the least. One of the gunboats would drop down every night and stand a twenty-four-hour watch over this mortar-boat. On the morning of the fight, the *Cincinnati* was lying just above the mortar-boat, made fast to the trees. Steam was down and all hands were busy holystoning decks. I was below writing a letter when I heard a shuffle of steps overhead and a quick, sharp command calling to quarters. I shall never forget the sight that met my eyes as I reached the deck. Steaming rapidly around the point below us, pouring dense clouds from their funnels, came first one vessel, then two, then more, until six war vessels under full steam came surging up the river barely a mile below us. Eight minutes would bring them alongside, while the *Cincinnati*, with barely enough steam to turn her wheel over, lay three miles away from the rest of the Union fleet, not one boat of which had enough steam up to hold itself against the current. The enemy's plan was to surprise and sink our ship, and get back before the rest of the fleet could reach the scene of action. They were very nearly successful, as will be seen.

THE "CINCINNATI" PREPARES FOR ACTION

"The *Cincinnati's* cables were slipped, and slowly she swung out into the stream. Her engineers were throwing oil and everything else inflammable into her fires to raise the necessary head of steam. On came the leader of the Confederate fleet, the *General Bragg*, a powerful gulf steamer. Her engines were pushing her along at a rate that raised a billow ten feet high before her bows. At a distance of not over fifty yards she received our full starboard battery of four thirty-two-pound guns.

"Cotton bales were seen to tumble and splinters fly; but on she came, her great walking-beam engine driving her at a terrific rate. When less than fifty feet away the *Cincinnati's* bow was thrown around and the two boats came together with a fearful crash. It was a glancing blow, and not the one she intended. A right-angle blow would have sunk us then and there. As it was, she took a piece out of us six feet deep and twelve feet long, filling the magazines with water, and knocking everything down from one end of the boat to the other. The force of the blow fastened the *Bragg's* ram temporarily into the *Cincinnati's* hull. 'Give her another broadside, boys!' passed the word of command. The men sprang with a cheer to their guns, and the entire broadside was emptied into the *Bragg* at such close range that the guns could not be run out of the ports. This broadside settled the *Bragg*, for she lay careened up against us so that it tore an immense hole in her from side to side. She slowly swung off from the *Cincinnati*, and, as the command to 'Board the enemy' was given, she lowered her flag.

RAMMED BY THE "SUMTER"

"But it is doubtful how much 'boarding' we could have done; for just at this moment the second Confederate ram, the *Sumter*, reached the scene of action, and coming up under full head of steam, struck the *Cincinnati* in the fantail, cutting into her three feet, destroying her rudders and steering apparatus, and letting the water pour into the hull of the boat. Before she struck us, however, our stern battery of two six-inch guns got two broadsides into her. And now came up the third Confederate ram, the *General Lovell*, aiming for our port quarter. 'Haul down your flag, and we will save you!' yelled someone, when she was less than fifty feet away. 'Our flag will go down when we do,' was the response. We got but one gun to bear on her, before the crash came. The *Cincinnati* was raised by the force of the blow enough to throw her bows under. The water was pouring in from three directions; the engineers were standing waist-deep in the engine-room; the fires were being rapidly extinguished; and we had just one more round of ammunition in the guns, the magazine being flooded. The *General Lovell* was filled with sharpshooters, who picked off every exposed man, including Commander Stembel, who fell with a Minié bullet through his mouth. First master Hoel, who assumed command, came down on the gun-deck and called out, 'Boys, give 'em the best you 've got, we ain't dead yet.'

THE "CINCINNATI" GOES DOWN WITH COLORS FLYING

"A cheer was his answer; and, as every gun of the boat poured its iron hail into one or another of the enemy, the *Cincinnati* rolled first to one side and then the other, gave a convulsive shudder, and went down bow-first and head on to the enemy. It was an exceedingly damp time for the crew of that boat. We all piled on the hurricane deck, and from that there was some tall and lofty scrambling for the wheelhouse, which, thanks to the shallow place we were in, remained above water. And now, perched like so many turkeys on a corncrib, we were enforced spectators of the exciting and magnificent scene around us. By this time our fleet from up the river had arrived at the scene of action, led by the flagship *Benton*. Running into the very midst of the enemy's fleet, she gave them first her bow battery of nine-inch Dahlgren guns, and then, wheeling, her starboard, stern, and port broadsides. By the time her bow swung around, her guns were again loaded; and, repeating her circling again and again, she delivered upon the enemy a withering sheet of death and destruction. Several of the Confederate rams tried to reach her, but were either intercepted by our other boats, that one after another joined the fight, or else were literally beaten back by the storm of shot and shell that poured from her sides.

"Soon the air was so full of smoke that little could be seen. Every now and then a Confederate ram would rush past us within a stone's throw, and then a shell would burst over our heads, or a solid shot plow up the water. But ten more minutes settled it. Two of the enemy's boats were floating broadside down the river,—the *General Bragg*, whose inside we blew out, and one other. The other four were making their best possible time for the shelter of the fort.

"We could not save our prizes, for we neither dared go after them, nor could we have towed them upstream if we had. The *Cincinnati's* wheelhouse was soon relieved of its dead and living freight, and, an hour afterward, the air and the mighty flood had swept away every vestige of the conflict."

CAPTURED BY MOSBY'S GUERILLAS

HOW A MAN FEELS WHEN DRAWING DEATH-LOTS, AS DESCRIBED BY ONE WHO DID IT

ABOUT the first of November, 1864, writes Brevet Major Charles Brewster, I received, at Winchester, a special order from army headquarters, which required me to go to the cavalry headquarters at the front. I started up the valley of Cedar Creek, accompanied by an ex-cavalry officer, my orderly, and another private.

Our route lay directly up the Shenandoah valley. The morning was cloudy, damp, and at times misty with slight rain. Being cool, overcoats with rubber ponchos were worn. We were all well mounted, and in the progress of our journey were approaching a crossroad near Newtown, when we observed upon another road, distant about half a mile on our right, a party of some fifteen mounted men, dressed as Union soldiers.

Although their movements seemed suspicious, we continued on our course in uncertainty, rather than take the chances of a timid, ridiculous retreat from a party of our own men. We approached at a walk, each party taking the right side of the road, and when we were abreast the strangers suddenly drew revolvers and wheeled their horses in front of us, demanding our surrender. With an average of three pistols held to each of our heads, there was nothing to do but obey. They then deprived us of our arms and money, and led us into an adjoining field. Here it was that, evidently with the expectation of making a profound impression, they announced that they were "Mosby's men."

While we waited in an old corncrib that occupied the crest of a hill, Mosby's men assembled from all parts of the surrounding country. All were irregular or, as they were more frequently designated, guerilla fighters. The hill seemed fairly to swarm with them.

SOME TO BE HANGED

At length we, the prisoners, were told by the guard to "fall in" and form a line along the outside of the building. We were then told

that seven of our number must be selected by lot and hanged in revenge for men hanged and shot as spies and irregulars by General Custer. The announcement was bravely received, although the stolid faces along our little line of twenty Union soldiers gradually turned pale as a full sense of the ordeal before us passed through each mind while preparations were being made for drawing the lot. One brief glance along our line showed heads bowed in prayer and eyes that were full of visions of the dear ones at home.

Presently three men appeared before the left of our line. One was a tall man with head uncovered, not from respect to those about him, but because just then he had a use for that hat in his hand. As he halted before the man at the left of the line, we understood the plan of the lottery.

The hat was raised so high that no one could see its contents, and the first man was directed to reach his hand into the hat and take out one piece of paper. This was done and a slip of paper taken out which was quickly examined by two attendants. This was repeated as they passed to each man in the line. Those who drew blank slips of paper remained in the line. Those who drew papers that were marked with numbers were considered condemned to death, and were immediately taken out of the line and placed under a special guard. When my turn came to draw, I reached my hand into the hat at once and seized, and distinctly felt, three pieces of paper. At this time I did not know how many had drawn numbers, but, having a vague idea that it was probably a matter of some concern to myself which one of the pieces of paper I selected, my action was a little slow. "Hurry up!" said the man holding the hat. As he spoke I let go one of the three slips, and, after an instant's pause, dropped the second piece and at the same time raised my hand with the remaining slip to decide my fate. It was quickly taken and examined by the guard, who pronounced that it was blank.

A SECOND LOT CALLED FOR

All of us had now drawn each one paper, but only five had drawn numbers, there having been an excess of blank slips in the hat. One of the five who had drawn the fatal slips was quite young and was so overcome as to attract special attention. Being found to be a mere lad, a drummer boy, Mosby ordered that he be freed as one who had not borne arms. This left only four condemned and three more to be drawn.

By this time the man with the hat had returned, and we were again straightened into line. The casting of lots was resumed, and the fifth and sixth men, with dumb, pale faces, stepped out of the line. After the sixth man had been drawn only four of us remained, and, as the first and second of these successively drew blanks, Lieutenant Disosway and myself exchanged glances which virtually said to one another, "One of us must be the seventh man, one of us must go."

THE DECISIVE DRAW, AND THE BRAVE LIEUTENANT'S FATE

The strain was awful. Being on my left, his turn came first. Then for an instant I knew that his thoughts were far away, with loved ones at home; but firmly and deliberately he placed his hand in the hat. Without waiting to see the result, I turned to look at the bright afternoon sun and the distant woods and thought, "Is this to be my last look?" The next instant I discovered the lieutenant's fatal drawing.

Then slowly raising his hat with one hand he passed his hand over his fevered forehead, and half turning to me he simply said, "This is tough!" For a moment we were permitted to remain standing side by side. Then we bade each other good-by as he turned away, and I never saw him again.

We were soon moving again, and a few miles of weary marching brought us to Sperryville about dark. Here I effected my escape alone, during the evening, by passing the sentinel while he was conversing with his comrades. Without stopping to recite the many experiences of my return trip to the Union lines, let me say that it was safely accomplished by the aid of the colored people along the way, who were all remarkably kind, and seemed to think that they could not do enough for me.

GENERAL GRANT COMES TO HIS OWN

GENERAL ULYSSES S. GRANT was the greatest of the Union generals. He was a man who hated war; but in actual warfare he was a fierce and relentless fighter. Wherever Grant went there was fighting instead of maneuvering. Belmont, Fort Henry, Fort Donelson, Shiloh, Vicksburg, Chattanooga, the Wilderness, Spottsylvania, Five Forks, Petersburg, Richmond, and Lee's surrender — these stand for events associated with his triumphant career. After he began to win battles President Lincoln felt that the great commander for whom he had longed had appeared.

GRANT'S DETERMINATION AND SELF-RELIANCE

When General Buell came upon the field at Shiloh after the first day's fighting, which had gone against the Union army, he thought that all was lost, and rode up to Grant saying, "What preparations have you made for retreating, General?"

To which Grant replied, "I have n't despaired of whipping them yet."

"But if you should be whipped," replied Buell, "how will your men cross the river? These transports will not take 10,000 men."

"If I have to cross the river," said Grant, "7000 will be all that I have to provide for." His army was then 30,000 strong, and the great commander meant that he would not be whipped while he had an army left to fight.

Grant used to say, "A general who will never take a chance in battle will never fight one." He was always surrounded by timorous advisers to whom, if he had yielded, he would have given up all that made his fame and brought victory to the Union arms.

During the advance on Richmond, in May, 1864, after a hard-fought battle, in which the losses in both Grant's and Lee's armies were very great, Grant's corps commanders met at his headquarters to request a council of war to consider the situation. They all advised Grant to fall back and cover Washington. The silent man listened, and at the conclusion of the council bade them good night. Near midnight he issued an order to his commanders to be in readiness at four o'clock next morning to "move to the front by the left flank" and engage the enemy. Upon receiving this order, several of the commanders collected immediately at Grant's headquarters to ask if there was not some mistake in the orders which they had received. He promptly asked, "What were the orders you received?" and, when his order was correctly reported, he replied, "Such were my orders." To this the timid ones replied that if he attempted such a movement Lee would go to Washington. Grant simply said, "If Lee goes to Washington, I will go to Richmond; be in readiness to execute my order."

Nothing could better illustrate Grant's self-reliance and courage than these few words.

THE CAPTURE OF FORT DONELSON

The battle which gave Grant his real fame was that of Fort Donelson. It was among the first real Union victories. Grant had attracted attention by the smaller success of Belmont, and had been promoted, much to the annoyance of many officers. He proposed to General Halleck the taking of Forts Henry and Donelson, Southern strongholds on the Cumberland River in Tennessee, and requested permission to undertake the task. These points must be passed before Vicksburg could be attacked, and Vicksburg was Grant's immediate goal. Halleck withheld his consent for some months, during which the forts were much strengthened.

Fort Donelson was on a bluff overlooking the river, which it commanded with its heavy guns. It was garrisoned by 21,000 men. Grant's army arrived before it on the 11th of February. It was a cold and stormy day. The lines were silently formed, completely investing the fort, and the men instructed to remain under arms, build no fires, and await the coming of the gunboats which would first storm the fort. Their sufferings from the cold were very severe. At last the gunboats arrived, but were able to do but little damage, as the fort, because of its height above the river, was able to keep them at a distance, or disable them when they approached. Admiral Foote asked Grant for a council, and

the general was absent from his lines for that purpose, when the Southern leaders, despairing of their ability to hold their position, prepared to cut their way through the Union lines. The resulting fight was a very fierce one, and for a time the Union forces gave way. A good idea of what took place may be gained from the account of a Union officer who was wounded in this battle.

COLONEL CHURCHILL'S ACCOUNT

"Shortly after daylight, the fighting commenced in earnest, almost the entire army of the enemy coming out and impetuously attacking Oglesby's brigade and ours, with the intention of cutting their way out to the Nashville road. About eleven o'clock the first brigade (Oglesby's) got out of ammunition and fell back. Logan's regiment was the last to go. At his request we covered his retreat by moving by the right flank in his immediate front. I was quite near him much of the time.

"He is a brave soldier. His eyes flashed like fire, and he was continually yelling to his men to 'Give it to 'em.' As he fell back he was shot through the arm. Shortly afterward Ransom (his colonel) was shot in the arm. My time was fully occupied in pulling the dead and wounded back out of the way, and getting cartridges from their boxes to replenish those of the men who were fighting. They kept a good line and not one attempted to run away.

"A very large man of our company, by the name of Thompson, told me that morning, when he saw the enemy, that he had a premonition that he would be the first man killed. It proved true. In a short time he was shot through the heart. The next man killed was Corporal Cronemiller, who was shot through the forehead and fell back into my arms, the hot blood spurting into my face. Between 7 A.M. and noon our regiment had 330 killed out of 452.

A DISPATCH BEARER KILLED

"Our brigade was ordered to retire shortly after Oglesby had fallen back, but the aide sent to our regiment was killed before reaching us. The ground was quite hilly, and we did not see the other regiments on our left, when they moved away. The enemy's infantry closed in on our flanks and Forrest's cavalry moved around and took position in our rear, and we were entirely surrounded. My attention was first drawn to this fact by some of our men being shot in the back. I notified Ransom, who had returned to the fight after being wounded. He immediately ordered the regiment to 'face about and charge cavalry,' which we did on the run, he in advance. Up to this time I had not been hit, although I had received two balls through my coat and one through my left trouser leg. When I had gone about a hundred feet, I felt as though I was suddenly struck with a leaden whip across the thighs, and was pitched headlong into a hole. My company passed on over me; I had been struck in the left thigh, just below the hip, by a 72-caliber musket bullet (nearly three-quarters of an inch), which flattened on the bone and came out in front. Of course, I learned this later. I did not know at the time with what or where I had been hit. I at once got up and followed on. Before reaching the cavalry line, I selected the point at which I would go through, and, when within ten feet of it, on turning my eyes to the right saw a cavalry man with his rifle pointed at me, not six feet away. I threw my revolver, which was in my left hand, around, but before I got a 'bead' on him he fired and I fell on and among a pile of dead and wounded. In falling my right wrist struck a sharply pointed stub, my hand opened, and my sword flew beyond reach. This time it was a Minié ball that had struck me in the center of the right hip socket from above, splitting off the outer half, and passing on down the thigh bone, fracturing it. The sensation was the same as before. I could not tell in which hip or thigh I had been hit. I attempted to get up, but could only raise my head; my hips and lower limbs were like lead. In a moment the enemy's infantry were passing over me, and in less than five minutes only their stragglers could be seen. The dead and wounded were thick about me. Within a radius of fifteen feet I counted fifteen dead men and a number of wounded. The air was filled with the cries of the wounded, to which it was pitiful to listen. Some with

boyish voices were calling 'Mother,' others shrieking as though in great agony, many groaning, and occasionally one swearing. Suddenly I heard heavy musket-firing in the rear."

GRANT ORDERS A CHARGE

At this moment, as a matter of fact, General Grant had come back from the conference with Admiral Foote, and had instantly grasped the situation. With his usual keen perception, he saw that the enemy was practically without a leader and in uncertainty, and he immediately ordered a charge. It was one of those brilliant orders of Grant's which his men were often at a loss to understand, and which they were loth to obey until they had learned that they usually meant victory. "The firing drew nearer. Suddenly I saw a large number of Confederate infantry passing by, many directly over me. I held up my hand, and none stepped on me. They were immediately followed by the bluecoats. I heard a voice say, 'Hullo, what is the matter with you?' On looking up I recognized Lieutenant Potts, whom I had known before the war."

We cannot follow farther the detailed account of Colonel Churchill. He was tenderly cared for and recovered from his frightful wounds. The Union army, following Grant's command, drove the Southerners back into their fort, and they surrendered unconditionally the next day. The victory did much to strengthen the Union cause, and General Grant's name was on every tongue.

A few years later General Grant was elected President, and received every proof of popular esteem. His mausoleum on the bank of the Hudson in New York is visited by thousands, and is a noble monument.

GRANT'S TOMB, RIVERSIDE DRIVE, NEW YORK CITY

Copyright, American Press Association

TWO HONORED VETERANS OF THE CIVIL WAR

Left: Gen. Louis Wagner. Right: Col. B. Beath, Past Commander-in-chief G. A. R.

UNDER FIRE AT GETTYSBURG

THE BATTLE THAT DECIDED THE FATE OF THE UNION

THE battle of Gettysburg takes rank as one of the greatest battles in history. It was fought between that portion of the Union army known as the Army of the Potomac, then under the command of Major-general George G. Meade, and the Confederate army of General Robert E. Lee. Lee had decided to carry the horrors of war into Union territory, all of the fighting thus far having taken place on Confederate soil. He had crossed the Potomac River and was marching through Pennsylvania, almost reaching Harrisburg, the capital; while Meade, then newly in command of the army, was establishing a line to hold him in check. This line was some miles to the north of Gettysburg, but, learning that Lee's troops seemed to be coming together in that neighborhood, he sent General Reynolds to discover their strength by opposing them with his division. It was not the intention of General Meade to offer battle at Gettysburg, but to have his troops withdraw to what he thought was a stronger position after having engaged the enemy and discovered in that way their true strength and position. It is said that the purpose of the Confederate army in going to Gettysburg was to supply themselves with shoes. Be that as it may, no sooner had they entered the town than they found themselves face to face with Federal troops. Both withdrew a short distance and camped that night so close together that their sentries could call to one another. On the morning of July 1 the three days' battle began. As the fighting grew sharper, the commanders of both armies began to send reënforcements, until by night nearly the whole of the Confederate army and a considerable part of the Union army was engaged. Meade now saw that a withdrawal would have all the effect of a defeat, and hastened up the remainder of his troops. They occupied rising ground in a long, curving line. The position was a strong one, considering the haste with which it was chosen and occupied. The Federal troops fought almost entirely on the defensive, the Confederate army making attack after attack on their position. With varying fortune at first, the Confederates were finally completely repulsed, and Lee's army recrossed the Potomac, never to fight again on Northern soil. It is generally held that this great battle was the turning-point of the war. The fighting was of the most determined description, more than half of the soldiers engaged on both sides being either killed, wounded, or taken prisoner.

PICKETT'S CHARGE

The most terrible struggle of the battle was that which followed Pickett's charge. General Pickett had been ordered by General Lee to take Round Top, a hill occupied by Union troops, and regarded by the generals of both armies as the key to the whole position. General Pickett was given eighteen thousand men, the flower of the Confederate army, with which to carry this position. The struggle is thus described by the aide of one of the Union generals:

"That noon," says Huntington W. Jackson, "General Newton and his staff lunched

GRANT AND LEE ARRANGING THE TERMS OF SURRENDER OF THE CONFEDERATE ARMY, APRIL 9, 1865

General Gibbon — General Custer — General Comstock — General Babcock — General Marshall — General Taylor — General Lee — General Sheridan — General Rawlins — General Grant — General Griffin — General Meade — General Parker — General Forsyth — General Bowers — General Merritt — General Ord

upon the field, between Cemetery Hill and Round Top, with General Hancock. When the simple repast was over, Newton directed me to ride along Doubleday's front and report the progress which had been made in completing the intrenchments. Hancock also requested that I should ride along his front and make a similar report. In obedience to these directions, I rode to the left of Doubleday's line and proceeded to his right along his front. The works were nearly finished and would afford excellent protection under any attack. The ground in front was open and fell away gently to the Emmetsburg road, where it began to rise towards the concealed position of the enemy. It was one o'clock when I had ridden the length of Doubleday's line and proceeded to Hancock's. At the same moment, one hundred and twenty-five guns from Seminary Ridge opened, and the air was filled with fire, smoke, and destruction. The noise was terrific. The effect of the firing was instantaneous. Many of our men were moving in the rear of our lines, going for water or hunting for rails with which to build fires to make their coffee; ambulances and wagons were driving from place to place, officers and orderlies were carrying dispatches and orders. In a moment all this ceased — more suddenly than, when a violent thunderstorm breaks over a city, the pedestrians seek shelter, and the streets are deserted. Everyone sought his proper post, and not a moving object could be seen except here and there a horseman passing over the field with impetuous speed.

"Thinking that the contest would prove to be nothing more serious than an artillery duel, and would end shortly, when I could again resume my ride, I dismounted, threw the reins over my horse's head, lay down, and hugged the earth. No sooner had the enemy's guns opened, than ours replied — eighty guns planted from Cemetery Hill to Round Top. Never before was such a duel witnessed. The very earth trembled and shook, and the air was alive with death-dealing bolts. The ground was literally plowed with shot and shell, throwing up dirt and stones in every direction. A number of men near me were killed and wounded. From my position, a few feet distant, a fine opportunity was given to see the bravery of Captain Rorty, commanding Battery B of the first New York Artillery, and his noble men. The battery was placed between the flanks of Doubleday and Hancock. The men, who were begrimed with powder, loaded with precision and speed, sighting and firing their guns as if the fate of the nation depended upon their exertions. The scene was more than dramatic. With guns dismounted, caissons blown up, and rapidly losing men and horses, the intrepid commander moved from gun to gun as coolly as if at a West Point review. While bringing up ammunition, some of the men, to lessen their exposure, dismounted before reaching the battery; but this the stern disciplinarian would not permit, and ordered them to remount and ride into position. Rorty had taken command of the battery three days before, only to fall at his post that afternoon. In the meantime the field was again alive with the wounded crawling to the rear and seeking surgeons, with caissons going for and bringing back ammunition, with fresh batteries rushing to the front to take the place of those disabled, and with the poor dumb beasts, many in number, some horribly mangled, and others hobbling along upon broken legs. The firing from the enemy's batteries continued for nearly two hours. The Union batteries, to prevent the exhaustion of their ammunition and to prepare for the climax of the day, ceased a short time before. It was as evident as if it had been announced by Lee himself where the enemy intended to strike.

PICKETT'S MEN ADVANCE

"Before the firing had wholly ceased and the smoke of battle which enveloped the field had lifted, Pickett's division with its supports, aggregating a force of eighteen thousand men, a solid phalanx, began to advance. Presenting a front of about half a mile in length, on they came, line upon line. Crossing the Emmetsburg road, all but Wilcox's brigade, which was the support on the right, turned slightly to the left, then forward, to the front, continuing to march directly towards the front of Gibbon's and Hayes' divisions of Hancock's troops. The supreme moment of the battle had arrived, and the Union batteries, some

Copyright, American Press Association

SCENES AT THE GETTYSBURG REUNION

Above: Old soldiers finding the names of their friends on a tablet. Below: Governor Tener of Pennsylvania addressing the veterans in the Assembly Tent.

double-shotted from the Cemetery to the Round Top, poured round after round of solid shot, shell, and canister into the compact ranks at the rate of four discharges a minute. The slaughter was fearful. Great gaps were torn through the columns, speedily to be closed up; and still they pressed on. Hancock's men stood ready to receive them. In a moment his entire front was ablaze with the fire of musketry. Hundreds were mowed down. Afterward, in going over the field, in a space but a few feet square, ten of the enemy's dead were seen lying one upon another. The Vermont brigade of Doubleday's division, made famous by their fine conduct in this, their first battle, formed a line at right angles to the established line of the army and opened a destructive raking fire upon the enemy's right flank. Shrinking from this unexpected attack, many threw themselves upon the ground, surrendering as prisoners; others fell to the rear.

PICKETT'S RETREAT

"After a desperate fight of a few moments in front of Hayes' division, the whole command broke and rushed back, leaving the field covered with the dead, dying, and wounded. Once, as they reached our lines, the Southern and Union flags could be seen a short distance apart, flying over the same works, and being waved to and fro by their color bearers as if imploring assistance.

"Starting from the summit of Round Top and continuing along to Cemetery Ridge and Culp's Hill, there went up cheer upon cheer from the men who were relieved from the terrible strain, anxiety, and anticipation of death. The wave of sound rolled from one end of the field to the other and back again for many minutes. A division of Union soldiers made a charge in front of Round Top, capturing a number of prisoners, flags, and cannon."

With this movement ended the battle of Gettysburg, and in a few days Lee's army was again upon the soil of Virginia. The North had been saved from further invasion, and the flower of the Southern troops had fallen. The blow was felt to be a crushing one. The coolness and bravery of the men on both sides were recognized by all, and from that day the men of both armies had a new respect for each other. Men of courage and honor are bound to like one another, and it is not strange, therefore, that the veterans of North and South should now meet as friends.

FIFTY YEARS AFTER

REUNION ON THE BATTLEFIELD OF GETTYSBURG

FIFTY years after the battle of Gettysburg a great reunion was held of both Northern and Southern soldiers who had taken part in that memorable fight. The wearers of the Gray and Blue walked side by side and talked together of this and that movement in which they had participated as mortal foes. All hostility was long since forgotten, and they joined hands as if they had been comrades in the same army. The history of the world contains no parallel to this marvelous scene.

Men who had fought face to face with a determination now tried only to outdo one another in expressions of brotherhood and loyalty to one flag and one country.

As Governor Tener of Pennsylvania said in his address of welcome, "All are content with the result of the struggle, and grateful that in defeat or victory there was left no stain upon American manhood and no question as to the bravery and devotion to duty of the American soldier."

More than forty thousand veterans of the war attended the great reunion, and of that number some fifteen hundred had participated in the battle itself. All of them were far advanced in years, and for many the journey to the battlefield from their distant homes was a task of no little difficulty. But, as one of them finely said, "It 's going to mean something to all the younger generation to have us old fellows get together and show there is n't any hard feeling. It will take away the last excuse for the young people to cherish any sectional animosity. It 's a duty we owe the country, about the last we can fill, most of us, and I figure out I ought to do it."

Naturally, many incidents of the deepest in-

Copyright, American Press Association

THE BLUE AND THE GRAY SHAKING HANDS ON THE TENTED FIELD OF PEACE

"You see, it was this way." "Yes, I remember that very spot!"

terest resulted from the meeting and the friendly discussion of the great struggle by the actors on both sides.

SOME OF THE GOOD STORIES

There were few boastful stories. One old hero, who had carried the Southern colors close to the crest of Round Top, was asked by an inquisitive sympathizer if he remembered a particular spot which the inquirer pointed out.

"Is it a little high?" inquired the veteran, languidly, "I don't see well. If it is, I reckon I was there. I touched most of them high places when I was movin'."

It developed that one "Yank," thinking that Pickett's men had won the day, hastened to throw down his arms. In a few minutes his Southern captor was himself a captive. Approaching a young officer he said, "I reckon you all got me and my prisoner. I hand him over to you. Take heed of him," and he gave up the too-excited Yank to his own commander.

THE FRIENDLY "REB" AND THE INTREPID YANKEE CHARGE

"Did you say that you were from the Second Massachusetts?" inquired a quiet, courteous Virginian wearer of the Gray. The veteran addressed having replied in the affirmative, the Southerner continued:

"Well, can you tell me what you fellows were trying to do when I hollered for you to go back?"

"Are you that fellow? Well, I want to tell you it made a tremendous impression on the few of us who heard you," and the two men joined hands in a hearty grip.

The incident referred to had occurred on the second day of the fight. The Second Massachusetts, then not more than three hundred and fifty strong, suddenly advanced from the Union lines, moved across an absolutely open meadow in full sight of the enemy, and deliberately charged their strongest position, held by ten times their number of Southern soldiers. A heavy fire was directed against them, and the men were falling at every step. In spite of these losses, the gallant regiment moved forward in perfect order. As they neared the enemy's position, a Southern soldier leaped on a rock and shouted at the top of his lungs, and with the greatest earnestness, "Go back! Go back! You can't possibly do it. For God's sake, fellows, go back!" Several of the Union soldiers distinctly heard him offering this evidently sincere and well-meant advice. The regiment at this moment, as if satisfied that they had done all that was required of them, and without the slightest sign of fear, faced about under the terrible fire in as perfect order as if on a parade ground, and retraced their steps. Reaching their original position, they again faced the enemy and returned their fire with telling effect. Over half of the officers, and nearly a third of the men, had been killed by this maneuver, which was executed throughout with a courage, coolness, and military precision seldom seen on review. It was the old story of mistaken orders. A message from headquarters to "feel the enemy's lines," which, in military language, means to skirmish cautiously and discover the enemy's position and strength, had been delivered as an order to take the enemy's position. Knowing that such a movement, if persisted in, meant the absolute annihilation of the command, the brave fellows nevertheless obeyed the order which cost so many of their lives. "It was the finest sight I ever saw, the way your men came forward!" exclaimed the Southerner.

"No," answered the Northern man, "it was not so fine as the chivalrous interest in the lives of brave men which prompted you to advise us to retreat!" And again the two old heroes clasped hands.

THE PRISONER'S STORY

"I believe that I had something to do with the battle of Gettysburg being fought," said a veteran of the Confederate army.

"How is that?" inquired a chorus of eager voices.

"Why, at the end of the first day's skirmishes, I was one of a squad of prisoners brought in from the front. I was immediately questioned by your secret-service men, and, as I was answering a question put to me by one of General Sharpe's staff, the general suddenly leaped to his feet, exclaiming, 'Why,

that man's regiment is in Ewell's corps! Prisoner, what 's your brigade?' 'Hay's Louisiana Brigade,' I replied. 'Whose division?' 'General Early's.'

"'I told you so,' cried General Sharpe to the officers around him; 'Ewell is here, the whole rebel army is in our front, and I am off to tell General Meade.' And springing upon his horse, he galloped away."

The Louisianian's story was correct. History tells us that information gathered from prisoners of the first day's fighting assured the Union generals that they were facing Lee's main army. All thought of falling back was removed, and daylight found the Union lines all strengthened and resolved to fight it out then and there.

A NURSE'S STORY

One or two old nurses attended the Gettysburg reunion. By one of these the following story was repeated, its touching human interest appealing to all:

"I attended a young Englishman, a color-bearer of a New York regiment. He had come to this country an orphan, and volunteered at the outbreak of the war. He had carried the colors of his regiment through all of the battles fought by the Army of the Potomac, and until now had escaped injury. All this he told me in broken sentences, and added that 'there was one on whom all his hopes centered,' and much more too sacred to repeat.

"To her, at his request, I wrote a letter, telling of his sad condition, and that, although he had lost his leg, he had saved the regimental colors, and his life might be spared. This was surely enough to make any true woman feel proud, particularly as I added, at his demand, that his thoughts were all of her.

"Not long after, as I attended him, I saw lying beside him on his pillow a letter directed in a lady's hand. I felt all would be well. Yes, the letter was delicately directed, delicately written, and delicately worded — but its meaning was not to be misunderstood. He handed me the letter to read, with a look of fixed despair, buried his head in the pillow, and wept. It was a cool, calm regret that she could no longer be his; to which was added the fear that the loss of his leg might affect his prospects in life. The blow had been sudden but sure. When he looked up again, his face bore the pallor of marble, and I saw there was no hope. He died, and his last words were, 'Tell her I forgive her.'"

Such an incident was the exception rather than the rule. For the most part the wives and mothers and sweethearts, North and South, endured suffering and privation with the greatest loyalty.

THE REVEILLE

After telling many stories and reviewing the fight charge by charge and incident by incident, the veteran host quietly left for home. They had given to America and to the world an object lesson of the highest test of courage, that which teaches men to be generous in victory and defeat. Rebel yells and Union cheers were all for the one flag that all hold dear.

"The star-spangled banner, oh, long may it wave,
O'er the land of the free, and the home of the brave."

Copyright, American Press Association

A PENNSYLVANIA BUCKTAIL AND HIS GRANDSON

Copyright, American Press Association

TOP: THE SYRACUSE DRUM CORPS: "STILL BEATING TIME, THOUGH GRAY." BOTTOM: A VETERAN TELLING WAR STORIES TO HIS GRANDDAUGHTER

TOP: COL. EDMUND BERKELEY AND REMAINDER OF HIS STAFF. MIDDLE: GENERAL VIEW OF CAMPS AT GETTYSBURG. BOTTOM: VETERANS ENJOYING A ROUGH MEAL

THE ESCAPE FROM LIBBY PRISON, SHOWING THE FIREPLACE EXIT AND CHIMNEY, THE CELLAR AND WALL WHICH WAS DUG THROUGH, AND THE TUNNEL WITH ITS TWO EXITS, ONE INSIDE AND THE OTHER OUTSIDE THE FENCE

THE GREAT ESCAPE FROM LIBBY PRISON

ONE OF THE MOST THRILLING ADVENTURES OF THE CIVIL WAR

IN the month of February, 1864, the country was astonished by the news that one hundred and nine men, Union soldiers, had escaped from the famous Libby prison, where the Confederate army kept so many of their prisoners of war. The following account of this remarkable escape is by one of the officers who had part in the adventure:

The party having in charge the work by means of which it was hoped to obtain entrance into the cellar, and which was engaged in working on the first tunnel, was composed of the following officers: Colonel Rose, Captain Lucas, Captain Gallagher, Lieutenants Galloway, Ludlow, Clifford, Brown, and Hamilton, with possibly two or three others. It must be remembered that our quarters were in the two upper stories, and that we had access only to the middle room on the first story, which was our cooking and dining room. At one point on the east side of this room was situated a fireplace, built into the massive brick and stone partition, which extended from basement to roof. Around this fireplace three stoves were placed for our use, leaving a very small space between the back of the stoves and the fireplace. It was at this point that someone conceived the idea of gaining entrance into the cellar, under the next room, which would give easy access to an outside wall, and a chance for tunneling. It will be seen that, if an opening could be made in the floor of this fireplace, by digging at an angle we would come out in the cellar of the next room, which was seldom if ever used.

THE FIRST TUNNEL

Captain Hamilton, who was a stone mason, removed the first brick and stone from the fireplace, through which we hoped to reach the basement. During the day the opening was

kept closed; and so skillfully were the bricks and stones replaced, aided by a few ashes and one or two worn-out skillets, thrown carelessly in, that one could never notice that anything had been disturbed. After I was aware that this opening existed, and that a working party was in the basement, I looked intently for something that might furnish a clew to our operations, but could discover nothing. Every possibility of detection was minutely guarded against. The cellar, to which we now had access, and from which the tunnel proper was started, was dark, rarely if ever opened, and had the appearance of not having been cleaned for years. We found there some straw, a few boards, some old boxes, some old stoves, and plenty of rats.

The first tunnel attempted was from the south end of this cellar, and was made with the intention of tapping the sewer between the prison and canal. This was given up on account of the terrible odor and the small size of the box sewer, making it impossible for a man to enter.

Bounding the prison on the east side was an alley, or narrow street, and on the opposite side of this from the prison were situated what I supposed to have been a warehouse and an unused stable. There was also a small yard concealed from view from the alley by a high board fence. The situation will be better understood by reference to the accompanying diagram (page 104).

One of the most difficult tasks of the entire work was to effect an opening in the foundation wall. It was accomplished, however, after great labor, and the tunnel was begun nearly on a line with the floor of the cellar, probably eight or nine feet below the surface of the ground. The distance to be tunneled was from seventy to eighty feet. The man at work was obliged to recline face downward, and the tools at his command were only common knives, small hatchets, sharp pieces of wood, and a broken fire shovel. After the tunnel was fairly begun it required two men to work successfully, one to dig, and another to haul back the earth, which was done in shallow frying-pans.

And now I must answer one question which is always asked at this point — "What did you do with the dirt?" It was distributed over the cellar floor, and straw carelessly scattered over it. Small quantities were placed in old boxes and barrels, a little here and there. There was not a great amount of it, as the tunnel was kept so small that a man could just crawl into it.

THE TUNNEL DISCOVERED

The time required for the digging of this tunnel was three weeks, and it was already half finished when I discovered it and was taken into the secret. I had been looking around for some possible means of escape, as we were all doing from time to time, when I approached the stoves and placed a light on one of them. Immediately a man whom I had not observed stepped up to me and whispered, "Please put out that light." I hesitated only a moment, and the thought flashed through my mind that someone was trying to force the lock in the door, and I was on the point of extinguishing the candle, when the man whispered again, "For God's sake, put out that light. To-morrow I will explain all." By this time the light was out, and I passed up to my quarters, wishing for the morning. I had recognized the officer, and, at a favorable moment, I interviewed him. It was Captain Lucas, of the tunneling party, and in charge of the work for that night. He was changing the working party, and had the opening behind the stoves in the fireplace uncovered. The light I had placed on the stove put the whole plan in peril. He charged me to absolute secrecy, to which I agreed, reserving the right to tell one man, who should be my companion in the attempt to escape. I immediately made application for a place on the working party, but was refused on the ground that there were already plenty of men who had had experience and could do better work than one unaccustomed to it; but the promise was made that I should be informed when the tunnel was completed.

I immediately confided the secret to my comrade, Captain Charles F. Rowan, and we began quietly to make arrangements for a sudden change of residence. I copied a little map of the peninsula, and, upon trifling excuses, borrowed or exchanged clothing more suitable for traveling in an enemy's country.

In the meantime we had determined to watch the movements of some we knew to be in the secret, and not depend upon being informed by anyone when the tunnel was completed. During the night of February 8 we became satisfied that the enterprise was finished; but no attempt was made to escape, although a number of those whose movements we were watching did not retire until very late. I have been informed since that it was the plan to open the extreme end of the tunnel during that night, and that the escape was to have taken place then. The tunnel was opened, but, dreadful to relate, it was on the wrong side of the fence, and in plain sight of the guards. A slight mistake in measurement had been made. The opening was immediately closed and the tunnel continued two feet, at which point a new opening was made in a safe place.

THE ESCAPE

During the evening of the ninth it was agreed that I should watch operations; and at half-past nine o'clock, most of the officers having retired, I visited the lower room and was surprised to find at least thirty men around the fireplace rapidly lowering themselves into the cellar. The exodus had begun. Hastily returning to my friend, I communicated the fact to him, and we were soon in the crowd around the first opening. We had provided ourselves with three or four loaves of prison bread, two or three pieces of meat, and an empty pop bottle for carrying water. Around the fireplace everything was conducted with terrible earnestness. There was very little order, but it was quiet. We found that everyone excepting ourselves belonged to someone's party, and everyone was going out first. It has been said that the managers of the tunnel believed that not more than one hundred among the eleven hundred officers imprisoned knew about the plan, and that it was intended that fifty should leave the first night. The prison clerk, not having a correct list of the prisoners, could easily be deceived, as he had often been before, so that fifty more could leave the second night, and so on. The officer charged with the responsibility of conducting the escape the second night, becoming convinced that no control could be exercised over the movements of the men escaping from the prison, became alarmed, and made his own escape. Of this I know only from report. But I do know that when we arrived at the fireplace as early as half-past ten in the evening, there was no order or plan. Everyone was for himself, and my companion and myself soon became part of the crowd and belonged to a party that was going out next, if possible. We accomplished our undertaking in just about fifteen minutes. I have always supposed that the working party made its escape first, and that my companion and myself were numbers thirty and thirty-one out of the tunnel.

As soon as we were at the fireplace my associate thrust his feet into the opening. He went down and out of my sight. In a moment I was in the cellar and conducted by my predecessor to the east wall and to the neighborhood of the opening of the main tunnel. Only one man was allowed in the tunnel at a time. The man preceding could be told by the stopping of the noise made by forcing one's body through the long, narrow shaft. I had dressed myself in an army overcoat, in which I had made two large inside pockets, and placed a loaf of bread in each. My head and shoulders passed into the tunnel without difficulty, but the enlargement caused by the bread in my pockets prevented me from going any farther. I drew back and took off the overcoat, and, pulling it behind me with my right hand, wormed myself through the tunnel.

This was no light and airy opening, but a narrow, dark, damp hole, just large enough for one to pull himself through; and the noise produced by one man kicking against the walls of this cavern was simply indescribable. The exact time consumed in passing through I cannot state; it could not have been more than two or three minutes. We had no way of knowing when we approached the external opening; but I remember that the shaft seemed to change direction abruptly upward and became even more contracted. I could proceed no farther, and stopped. Someone whispered to me, "Don't breathe so loud, stop blowing!" At the same time I felt a hand, which I grasped and was pulled out of the

opening. My assistant proved to be my companion, Captain Rowan.

PASSING THE GUARDS

We could now breathe once more the pure air of heaven, but our dangers were by no means past. Not only were we very close to the guard, but we were in the center of the Confederate capital. We crept very cautiously behind the fence into an open carriageway, toward the canal. Once there we were for the moment out of sight of the guard. It was necessary to pass from the vicinity of the prison singly, or by twos, in order to avoid suspicion. All of those who had escaped before us had disappeared except one. He told us the manner of escaping from the immediate neighborhood that had been successful up to this time, and then he passed out. We waited to tell the plan to the next party, and so in turn each was given the benefit of the experience of those preceding him. We were in the carriageway fronting on the canal. Four guards were slowly pacing along the north side of the prison. The guard on the east met his fellow at the southeast corner, and the same thing happened at the southwest corner. We were thus within three hundred feet of six armed men whose duty it was to shoot us if they observed us. From our shadowed position in the carriageway, we could look up and down the street, and, choosing a moment when it was comparatively clear, we passed out and walked slowly down the canal, in full view of the guards, but we were either not seen or supposed to be citizens. This was a most dangerous point, and yet not one of the one hundred and nine men who passed out was halted by a guard. We walked probably two blocks on Canal Street, and then turned abruptly to the left and were for the first time out of range of the guards' muskets. Of course, we took a long breath. Continuing our course to the left one block, we came to Carey Street, which was brilliantly lighted, many of the shops being still open. We observed a group of soldiers walking in front of us, talking and laughing. They were on the way back to some Confederate camp after having spent the evening in the city. We mingled freely with them, talking to ourselves on subjects similar to those we heard them discussing. We avoided coming in direct contact with them, however, and gradually, as we approached the outskirts of the city, allowed them to pass us, until at last, having been in their company half an hour, we found ourselves alone on the Charles City Railroad, about one mile to the east or southeast of Richmond.

THROUGH THE ENEMY'S COUNTRY

We had up to this time made no plans for our journey. We knew something of the position of the Army of the Potomac. We knew that West Virginia was mountainous and that a trip in that direction would consume weeks, perhaps months. We also knew that our forces occupied Fortress Monroe, with outposts some distance up the peninsula. We decided at once to attempt to make the latter point, and, with nothing but the Pole Star to guide us, we started. We traveled nights and secreted ourselves in the daytime. On the sixth night the strength of my companion all at once seemed to disappear. From the terrible mental and physical exertions of the week, from hunger and cold, he became absolutely prostrated. I urged him forward with all the powers of persuasion left, but a little before daylight we were obliged to stop and rest. At sunrise we concluded to travel during the forenoon, as we were confident that our troops must be near us, and as the country was too open and exposed for successful concealment. In fact, we felt that it was the last effort that we could make, and for the first time we traveled in a road. About nine o'clock there suddenly appeared at a turn in the road a squad of cavalry, a few hundred yards before us. We recognized them at once as our own men and knew that we were safe. No one can describe the kindness shown to us by this body of men. Every attention was showered upon us. We were banqueted and fêted, and banqueted again. As soon as possible we reported at Washington. Every paper was filled with the story of the escape from Libby prison. It appeared that fifty-five out of the hundred and nine had reached our lines and the rest had been recaptured.

CUSTER'S LAST RIDE

General Custer was a dashing and daring officer, whose courage made him reckless, and led him to underestimate the Indians.

THE MASSACRE OF CUSTER'S TROOP

CUSTER'S QUARREL WITH RAIN-IN-THE-FACE

THE country watered by the Yellowstone and its tributaries, crossed by the Black Hills, and other ranges of mountains, and protected by the Bad Lands in Dakota, had been up to 1873 an unknown country. Then the Northern Pacific Railroad began a survey to find a route across it, and, gold having been discovered, miners and settlers began to appear. The Indians, ever since the last trouble, had been in a bad mood. They welcomed neither railroad nor men. An expedition was sent into the country, and Custer and his regiment formed a part of it. In a clash with the Indians, two civilians attached to the command were found and murdered by the Indians. The soldiers were much incensed. The next year, 1874, the Seventh Cavalry (Custer's command) being stationed at Fort Abraham Lincoln, near Bismarck, Dakota, word was brought to Custer that a famous Sioux, called Rain-in-the-Face, was at Standing Rock Agency boasting that it was he that killed the two men the year before. Custer immediately determined upon his capture, although it would be a difficult and dangerous thing to attempt. Tom Custer, with five picked men, was ordered to enter the store and make the arrest. The store was full of Indians. The weather was very cold, and the Indians kept their blankets well around their faces. It was impossible to tell one from another. At last one Indian dropped his blanket and stepped to the counter, either to speak to the trader or make a purchase. It was Rain-in-the-Face. Custer recognized him immediately. Stepping behind him, he threw his arms about him and seized him in

an iron grasp. The five troopers sprang to the side of their captain, disarmed Rain-in-the-Face, and presented their guns to the astonished and infuriated Indians. The Indians would have made short work of these men had not Captain Yates at this moment entered the room with a detail of his men.

Rain-in-the-Face was put in the guard-house to be tried for murder. In the same guard-house were some civilians arrested for stealing. One bitterly cold night, during a raging blizzard, the two civilians made their escape, and Rain-in-the-Face took advantage of the opportunity and left also. He joined the hostiles under Sitting Bull, and sent back word that he intended to have his revenge on the Custers for the treatment he had received.

CUSTER REBUKED BY GRANT

For some reason General Custer, one of the finest soldiers that ever lived, disliked General Belknap, the Secretary of War. When Belknap was imprisoned and about to be tried, Custer wrote that he knew of certain things regarding the appointment of post traders that would help the prosecution. He was summoned to Washington, but, upon being questioned, it was seen that he had nothing to offer but hearsay. President Grant was indignant, and directed General Sherman not to permit Custer to take the field against Sitting Bull. This was undoubtedly to punish Custer. Finally, at the urgent request of General Sheridan, Custer was permitted to go at the head of the Seventh Cavalry, but not in command of the expedition. On the 17th of May the command left Fort Lincoln. The seriousness of the situation was felt as never before in an Indian campaign. It was realized that no child's play was before the troops.

They reached the Powder River without mishap, and there were joined by General Gibbon, who reported that he had discovered a big Indian trail leading westward towards the Big Horn country. Custer was directed to march southward until he struck this trail. The general plan was to hem the Indians in and, after inflicting severe punishment upon them, compel the remainder to return to the agencies and reservations.

But Custer did not obey orders. Smarting under the rebuke which had been given him by the President, he was anxious to do something to wipe out the disgrace. Therefore, when he suddenly found himself face to face with the enemy, instead of holding them from moving in an easterly direction until the other troops should come up from the north, south, and east, he decided to attack them single-handed and gain the whole credit of victory for himself and his command. At least this is what the best available facts seem to indicate. At any rate, the attack was made. Custer followed on a smaller scale the plan of the larger body. He divided his force into three sections, intending to swoop down upon the Indians from three points at once. It was the usual method of Indian warfare at that time, and Custer was a veteran Indian fighter. Unfortunately, the officers to whom he was compelled to commit the flank movements were not as experienced as himself. They were forced to meet sudden attacks from the Indians, who understood far more of what was going on than they were supposed to. And, in the excitement of these attacks, they lost sight altogether of the general plan, and left General Custer to meet the main body of Indians unsupported. In their ignorance of Indian warfare they supposed that they were attacked by far more Indians than was the fact, and believed that they were facing the principal force themselves. It was, of course, their duty to have obeyed orders. Suddenly the sound of distant firing was heard, and the Indians began to disappear from around them. Some of the older officers were insistent that they should go to Custer's aid, suspecting what was happening. But the tardy commander moved too late.

THE STORY OF RAIN-IN-THE-FACE

The best account we have of what actually occurred at the annihilation of Custer and his command is the story of Rain-in-the-Face, as he gave it to Mr. W. Kent Thomas, who published the account in *Outdoor Life*.

"If you want a story I will tell a true one," said the old Indian chief. "It 's about myself. I was a bad man and dangerous to fool with before I had to walk with crutches. My

heart's good now, but it was all the time bad when I was a fighter and a hunter. Two years before the big fight, Gall and Sitting Bull had their camp at Standing Rock. All were hostiles.

INDIAN CHIEF OF THE PRESENT DAY

They were Unkpapa Sioux and fighters who never feared an enemy any more than a buffalo calf. The 'Yanktonais' (friendly Indians) were coffee-coolers (cowards) and hung around the agency which was at Lincoln."

Mr. Thomas then drew a map of the fight, as it was generally understood to have happened, and showed it to the Indian.

"Does that look anything like the fight?"

Rain-in-the-Face studied it for a long time.

"No," he said, "this picture is a lie. These long-swords (Indian name for cavalry soldiers) have swords. They never fought us with swords, but with guns and revolvers. These men are on ponies. They fought us on foot, and every fourth man held the others' horses. That's always the way they fight. We tie ourselves on to our ponies and fight in a circle. These Indians (referring to the picture) are not dressed as we dress when we fight. They look like agency Indians. We strip naked and have ourselves and our ponies painted. This picture gives us bows and arrows. We were better armed than the long-swords. Their guns would n't shoot but once. The thing would n't throw out the empty shells." (In this he was correct. Dozens of guns were picked up on the battlefield two days after the fight, with the shells still sticking in them.) We spared none. Ugh! This picture is like all white man's pictures of Indians. It is a lie.

"We knew they had made a mistake when they separated. I had sung my war song, I had smelt the powder smoke. My heart was bad. I was like one that has no mind. I rushed in and took their flag. My pony fell dead as I took it. I cut the cord that tied me, and ran back to our line with the flag. I got a fresh pony and rushed back, shooting, cutting, and slashing.

"This time I saw Little Hair. I remembered my word. I was crazy. I feared nothing. I knew nothing would hurt me, for I had my white weasel-tail charm on. I don't know how many I killed trying to get at him. He knew me. I laughed at him and yelled at him. I saw his mouth move, but I could not hear what he said. He was afraid. When I got near enough I shot him with my revolver. My gun was gone, I don't know where. I did n't scalp him."

This account was given by Rain-in-the-Face at the time of the World's Fair at Chicago. He was then about sixty years old and still a giant of great strength. It is the most remarkable account of a fight with white men ever given by an Indian. It accords with all of the facts that are known, and is probably a correct account of the manner in which the great soldier and his splendid command, the Seventh Cavalry, were completely annihilated.

CROSSING A PERILOUS CHASM IN THE GLACIERS

THE ASCENT OF MONT BLANC

HOW THE PERILS AND WONDERS OF THE GLACIER WORLD THRILL THE DARING CLIMBER

AS the highest peak of the Alps, Mont Blanc was the aspiration of daring climbers for nearly a century before the first human foot stood upon its summit, and has ever remained a favorite attempt for the hardy. Mr. Albert Smith, who made one of the successful ascents many years ago, told the story in a way to stir the pulses of all mountain lovers.

Having a free fortnight, he tells us that he filled his old knapsack, which had seen use in the Alps already, and sped away to Chamouni, where his old guide, Jean Tairraz, was ready to further his plans. Three young men joined to make up a party, bad weather cleared as if by magic, and soon all was hurry and preparation for the next morning's start. All the village was in excitement, for in that day an attempt to make the summit was an event, and success meant an ovation. Now the story proceeds :

About half-past seven we started, and as we left the inn, and traversed the narrow street towards the bridge, I believe we formed the largest caravan that had ever gone off together. Each of us had four guides, making twenty in all, and a score of porters and volunteers, besides a rabble rout of friends and relations, sweethearts and boys.

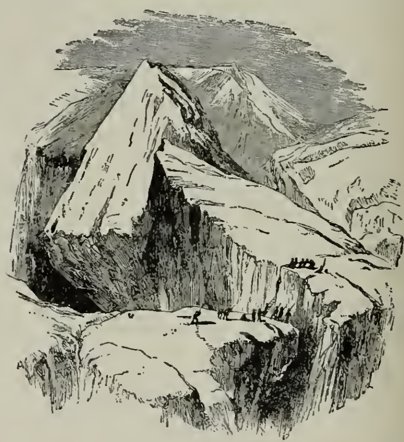
The first two hours of the ascent presented no remarkable features, either of difficulty or prospect. The path was very steep and rugged, through a stunted copse of pines and shrubs, between which we saw on our right the glistening ice-towers of the lower Glacier des Bossons, on our left a ravine with a torrent. We kept on in single file until we came to the last habitation up the mountain. From this point the vegetation gradually became more scanty, and at last even the fir trees no longer grew about us. The hillside was bare and arid, covered with the débris of the spring avalanches, and some goats were trying very hard to pick

up a living. Our caravan was now spread about far and wide; but at half-past nine we came to an enormous block of granite, called the Pierre Pointue, and here reunited our forces and rested awhile.

WHERE A STRONG HEAD IS NEEDED AND A SLIP MEANS DEATH

Hitherto we had been on the ridge of one of the mighty buttresses of Mont Blanc, which hem in the glaciers between them; we had now to climb along its side to gain the ice. This part of the journey requires a strong head: here, and towards the termination of the ascent, dizziness would be fatal. Along the side of the mountain, which is all but perpendicular, the goats have worn a rude track, scarcely a foot broad. On your left your shoulder rubs the rock; and on your right there is a frightful precipice, at the bottom of which, hundreds of feet below you, is that confusion of ice, granite blocks, stones, and dirty roaring water which forms in its *ensemble* the boundary of a glacier. The view is superb, but you dare not look at it. It is only when the loose ground crumbles away beneath your right foot, and you nearly slide away over the precipice — you would do so if the guide did not seize you by the arm with the sudden grip of a vise — that you give up staring about you, and do nothing but carefully watch the footsteps of the man who is going on before. The path goes up and down — its gradual tendency, however, is to descend; and in about twenty minutes we had arrived at the bottom of the ravine. Here we had another half-hour's troublesome scramble over loose bowlders, which threw and twisted our ankles about in every direction, until at last we gained the second station, if it may so be called, of our journey — another huge rock called the Pierre à l'Echelle, under shelter of which a ladder is left from one year to the other, and is carried on by the guides, to assist them in passing the crevices on the glacier. The remains of an old one were likewise lying here, and the rungs of it were immediately seized for firewood.

We were now four thousand feet above Chamouni, and the wonders of the glacier world were breaking upon us. The edge of the ice was still half an hour's walk beyond this rock, but it appeared close at hand — literally within a stone's throw. So vast is everything that surrounds the traveler — there is such an utter absence of any comprehensible standard of comparison — his actual presence is so insignificant — a mere unheeded, all but invisible, speck on this mountain world — that every idea of proportionate size or distance is lost. And this impossibility of calculation is still further aided by the bright clear air, seen through which the granite outlines, miles



A PERILOUS CREVICE

away, are as sharply defined as those of the rocks you have quitted but half an hour ago.

Far below us, long after the torrents had lost themselves in little gray threads among the pine-woods, we saw the valley of Chamouni, with its fields and pastures parceled out into parti-colored districts, like the map of an estate sale; and we found the peaks of other mountains beginning to show above and beyond the lofty Brevent. Above us, mighty plains of snow stretched far and away in all directions; and through them the ice-crags and pinnacles of the two glaciers, Bossons and Tacconay, were everywhere visible. On either side of us, at the distance perhaps of a couple of miles from each other, were the two huge buttresses of

Mont Blanc which form the channel of the glacier before alluded to. High up the sides of these mountains were wondrous cornices of ice, of incalculable weight, threatening to fall every instant. Pieces now and then tumbled down with a noise like distant thunder; but they were not large enough to be dangerous. Had a block of several tons descended at once, its momentum would have carried it along the glacier, sweeping everything before it; and of this occurrence the guides are constantly in dread.

We rested here nearly half an hour, and made a famous meal. The morning was so bright, and the air so pure, and the view so grand, if the guides had not beaten us up again into marching order, we should have dawdled

PASSING THE GLACIER DES BOSSONS

about this Pierre à L'Echelle for half the day. So we took our batons and started off again; and, after a troublesome scuffle over the grimy border of the glacier, we reached its clean edge, and bade good-by to firm footing and visible safety for the rest of the excursion.

The first portion of the journey across the Glacier des Bossons is easy enough, provided always that the outer crust of the snow lying upon it is tolerably hard. We marched on in single file, the guides taking it by turns to lead (as the first man had, of course, the heaviest work), amid cliffs and hillocks, and across dark-blue color which the sky apparently assumes. Our veils and glasses now proved great comforts; for the sun was scorching, and the blinding light from the glaciers actually distressing. By degrees our road became less practicably easy. We had to make zigzag paths up very steep pitches, and go out of our line to circumvent threatening ice-blocks or suspected crevices. All this time we had been steadily ascending; and at last the glacier was so broken, and the crevices so frequent and hugely gaping, that the guides tied us and themselves together with cords, leaving a space of about eight feet between each two men, and prepared for serious work.

The traveler who has only seen the Mer de Glace can form no idea of the terrific beauty of the upper part of the Glacier des Bossons. He remembers the lower portions of the latter, which appears to rise from the very cornfields and orchards of Chamouni, with its towers and ruins of the purest ice, like a long fragment of quartz inconceivably magnified; and a few steps from the edge of Montanvert will show him the icy chasms of the Mer. But they have little in common with the wild and awful tract we were now preparing to traverse. The Glacier des Bossons, splitting away from that of Tacconay, is rent and torn and tossed about by convulsions scarcely to be comprehended; and the alternate action of the nightly frost and the afternoon sun on this scene of splendid desolation and horror, produces the most extraordinary effects. Huge bergs rise up of a lovely pale sea-green color, perforated by arches decorated every day with fresh icicles many feet in length; and through these arches one sees other fantastic masses, some thrown like bridges across yawning gulfs, and others planted like old castles on jutting rocks commanding valleys and gorges, all of ice. There is here no plain surface to walk upon; your only standing-room is the top of the barrier that divides two crevices; and, as this is broad or narrow, terminating in another frightful gulf, or continuous with another treacherous ice wall, so can you be slow or rapid. The breadth of the crevice varies with each one you arrive at, and these individually vary constantly, so that the most experienced guide can have no fixed plan of route. The fissure you can leap across to-day becomes by to-morrow a yawning gulf.

Young Devouassoud now took the lead, with a light ax, to cut out footsteps and hand-holds

with when necessary, and we all followed, very cautiously placing our feet in the prints already made. Our progress was necessarily very slow; and sometimes we brought up altogether for a quarter of an hour, while a council was held as to the best way of surmounting a difficulty. Once only the neck of ice along which we had to pass was so narrow that I preferred crossing it saddle fashion, and so working myself on with my hands. It was at points similar to this that I was most astonished at the daring and sure-footedness of the guides. They took the most extraordinary jumps, alighting upon banks of ice that shelved at once clean down to the edges of frightful crevices, to which their feet appeared to cling like those of flies. And yet we were all shod alike, in good stout "shooting-shoes," with a double row of hobnails; but where I was sliding and tumbling about, they stood like rocks. In all this there was, however, little physical exertion for us; it was simply a matter of nerve and steady head. Where the crevice was small, we contrived to jump over it with tolerable coolness: and where it was over three or four feet in breadth, we made a bridge of the ladder, and walked over on the rounds. There is no great difficulty, to be sure, in doing this, when a ladder lies upon the ground; but with a chasm of unknown depth below it, it is satisfactory to get to the other side as quickly as possible.

At a great many points snow made bridges, which we crossed easily enough. Only one was permitted to go over at a time; so that, if it gave way, he might remain suspended by the rope attached to the main body. Sometimes we had to make long detours to get to the end of a crevice, too wide to cross anyway; at others, we would find ourselves all wedged together, not daring to move, on a neck of ice that at first I could scarcely have thought adequate to have afforded footing to a goat. When we were thus fixed, somebody cut notches in the ice, and climbed up or down, as the case required; then the knapsacks were pulled up or lowered; then, we followed, and finally the rest got on as they could.

One scramble we had to make was rather frightful. The reader must imagine a valley of ice, very narrow, but of unknown depth. Along the middle of this there ran a cliff, also of ice, very narrow at the top, and ending suddenly, the surface of which might have been fifteen feet lower than the top of this valley on either side, and on it we could not stand two abreast. A rough notion of a section of this position may be gained from the letter W, depressing the center angle, and imagining that the cliff on which we were standing. The feet of our ladders were set firm on the neck of the cliff, and then it was allowed to lean over the crevice until its other end touched the wall, so to speak, of the valley. Its top round was, even then, seven or eight feet below where we wanted to get. One of the young guides went first with his ax, and contrived, by some extraordinary succession of gymnastic feats, to get safely to the top, although we all trembled for him — and, indeed, for ourselves; for, tied as we all were, and on such a treacherous standing, had he tumbled he would have pulled the next after him, and so on, one following the other, until we should all have gone hopelessly to perdition. Once safe, he soon helped his fellows, and, one after the other, we were drawn up, holding to the cord for our lives.

Our porters would go no farther; promises and bribes were now in vain; and they gave up their luggage, and set off on their way back to Chamouni. We now felt, indeed, a forlorn hope; but fortunately we did not encounter anything worse than we had already surmounted, and about four o'clock in the afternoon we got to the station at which we were to remain until midnight.

THE NIGHT-BIVOUAC IN THE SNOW ON THE GRANDS MULETS

The Grands Mulets are two or three conical rocks which rise like island peaks from the snow and ice at the head of the Glacier des Bossons. They are visible to the naked eye from Chamouni, appearing like little cones on the mountain side. Looking up to them, their left-hand face, or outer side, goes down straight at once, some hundred feet to the glacier. On the right hand, and in front, you can scramble up to them pretty well, and gain your resting-place, which is about thirty feet from the summit, either by climbing the

WINTER SCENES IN SWITZERLAND

rock from the base, which is very steep and fatiguing, or by proceeding farther up along the snow, and then returning a little way, when you find yourself nearly on a level with your shelf — for such it is. A familiar example of what I mean is given in a house built on a steep hill, where the back door may be on the third story.

The ascent of this rock was the hardest work we had yet experienced: it was like climbing up an immense number of flagstones, of different heights, set on their edges. Before we got halfway, we heard them firing guns at Chamouni, which showed us that we were being watched from the village; and this gave us fresh energy. At last we reached something like a platform ten or twelve feet long, and three or four broad; and below this was another tolerably level space, with a low parapet of loose stones built round it, while here and there were several nooks and corners which might shelter people on emergency. We acknowledged the salute at Chamouni by sticking one of our batons into a crevice and tying a handkerchief to the top of it; and then set to work to clear away the snow from our resting-place. The heat we here experienced was most sultry, and even distressing.

As soon as we had arranged our packs and bundles, we began to change our clothes, which were tolerably well wet through with trudging and tumbling about among the snow; and, cutting a number of pegs, we strewed our garments about the crannies of the rocks to dry. I put on two shirts, two pairs of lamb's wool socks, a thick pair of Scotch plaid trousers, a "Templar" worsted headpiece, and a common blouse; and my companions were attired in a similar manner. There was now great activity in the camp. Some of the guides unpacked the refreshment knapsacks; others made a rude fireplace and filled a stewpan with snow to melt. We perched ourselves about on the comparatively level spaces of the rock, and began our dinner.

We kept high festival that afternoon on the Grands Mulets. One stage of our journey, and that by no means the easiest, had been achieved without the slightest hurt or harm. The consciousness of success thus far, the pure transparent air, the excitement attached to the very position in which we found ourselves, and the strange bewildering novelty of the surrounding scenery, produced a flowing exhilaration of spirits that I had never before experienced.

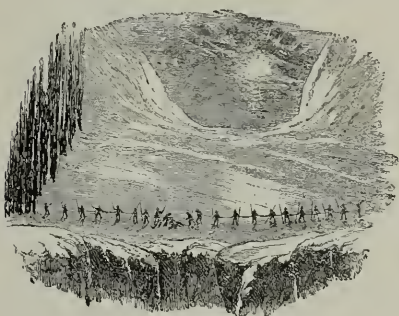
The Grands Mulets rocks are evidently the highest spines, so to speak, of a ridge of the mountain dividing the origin of the two glaciers of Bossons and Tacconay. They are chosen for a halting-place, not less from their convenient station on the route than from their situation out of the way of the avalanches. From the western face of the peak on which

BIVOUAC ON GRANDS MULETS

we were situated we could not see Chamouni, except by climbing up to the top of the rock — rather a hazardous thing to do — and peeping over it, when the whole extent of the valley could be very well made out, the villages looking like atoms of white grit upon the chequered ground. Below us, and rising against our position, was the mighty field of the glacier — a huge prairie, if I may term it so, of snow and ice, with vast irregular undulations, which gradually merged into an apparently smooth unbroken track as their distance increased. Towering in front of us, several thousand feet higher, and two or three miles away, yet still having the strange appearance of proximity that I have before alluded to, was the huge

Dôme du Goûté — the mighty cupola usually mistaken by the valley travelers for the summit of Mont Blanc. Up the glacier, on my left, was an enormous and ascending valley of ice, which might have been a couple of miles across; and in its course were two or three steep banks of snow, hundreds of feet in height — giant steps, by which the level landing-place of the Grand Plateau was to be reached. Still farther up, above the level which marked the Grand Plateau, was the actual summit of Mont Blanc.

The sun went at length down behind the Aiguille du Goûté, and then, for two hours, a scene of such wild and wondrous beauty — of



CROSSING THE GRAND PLATEAU AT NIGHT

such inconceivable and unearthly splendor — burst upon me, that, spellbound, and almost trembling with the emotion its magnificence called forth, with every sense and feeling and thought absorbed by its brilliancy, I saw accomplished far more than the realization of the most gorgeous visions one could imagine. At first, everything about us, above, around, below — the sky, the mountain, and the lower peaks — appeared one uniform creation of burnished gold, so brightly dazzling, that, now our veils were removed, the eye could scarcely bear the splendor. As the twilight gradually crept over the lower world, the glow became still more vivid; and presently, as the blue mists rose in the valleys, the tops of the higher mountains looked like islands rising from a filmy ocean — an archipelago of gold. By degrees this metallic luster was softened into tints — first orange, and then bright, transparent crimson, along the horizon, rising through the different hues with prismatic regularity, until immediately above us the sky was a deep, pure blue, merging towards the east into glowing violet. The snow took its color from these changes, and every portion on which the light fell was soon tinged with pale carmine. These beautiful hues grew brighter as the twilight below increased in depth, and it now came marching up the valley of the glaciers, until it reached our resting-place. Higher and higher still it drove the lovely glory of the sunlight before it, until at last the vast Dôme du Goûté and the summit itself stood out ice-like and grim, in the cold evening air, although the horizon still gleamed with a belt of rosy light.

Although this superb spectacle had faded away, the scene was still even more than striking. The fire which the guides had made, and which was now burning and crackling on a ledge of rock a little below us, threw its flickering light, with admirable effect, upon our band. The men had collected round the blaze, and were making some chocolate, as they sang patois ballads and choruses: they were all evidently as completely at home as they would have been in their own chalets. We had arranged ourselves as conveniently as we could, so as not to inconvenience one another, and had still nothing more than an ordinary wrapper over us: there had been no attempt to build the tent with batons and canvas, as I had read in some of the Mont Blanc narratives — the starry heaven was our only roofing.

THE NIGHT-MARCH ON THE GRAND PLATEAU — THE MUR DE LA CÔTE — VICTORY!

It was twenty minutes to twelve when the note of preparation for our second start was sounded. This quarter of an hour before midnight was, I think, the heaviest during the journey. The moon was still low — so that we were in comparative darkness. Three or four lanterns were fitted up with candles; and Jean Tairraz had a fine affair like a Chinese balloon, or, more truly, the round *lampions* used in French illuminations, only larger; and this he tied behind him, to light me as I

followed. Michel Devouassoud took the lead; we came after him with regular numbers of guides, each traveler having a lantern carried before him, and then another guide or two, lightly laden. In this order, in single file, we left the Grands Mulets by the upper portion of the rocks, where we descended at once, in a few feet, to the snow.

The snowy side of Mont Blanc, between the Grands Mulets and the Rochers Rouges near the summit, is formed by three gigantic steps, if they may be so called, one above the other, each of which is many hundred feet high. Between each is a comparatively level platform of glacier; and the topmost of these, which is two or three miles across, is called the Grand Plateau. Its position can be made out very well from Chamouni with the naked eye. Up these slopes our road now lay, and for more than two hours we followed one another in silence — now trudging over the level places, and now slowly climbing in zigzag up the steeps. Very little talking went on, for we knew that we should soon need all our breath. The walking here, however, was by no means difficult, for the snow was hard and crisp, and we made very good progress, although for a long time we saw the red speck of fire, far below us, gleaming on the Grands Mulets. The air was sharp and cold, but only disagreeably biting when the lightest puff of wind came.

The march from the Mulets to the foot of the Grand Plateau was one continuous, steadily ascending tramp of three hours and a half. Whenever we came to a standstill, our feet got very cold, and the remedy for this was to drive them well into the snow. The guides were anxious that we should constantly keep in motion.

We had nearly gained the edge of the Grand Plateau when our caravan was suddenly brought to a stop by an announcement from our leading guide of a huge crevice ahead to which he could not see any termination; and it was far too wide to cross by any means. It appeared that the guides had looked forward, all along, to some difficulty here — and they were now really anxious, for Tairraz said that if we could not reach the other side our game was up, and we must return. Auguste Devouassoud went ahead and called for a lantern. We had now only one left alight; two had burnt out, and the other had been lost, shooting away like a meteor down the glacier until it disappeared in a gulf. The remaining light was handed forward, and we watched its course with extreme anxiety, hovering along the edge of the abyss — anon disappearing and then showing again farther off — until at last Auguste shouted out that he had found a pass, and that we could proceed again. We toiled up a very steep cliff of ice, and then edged the crevice which yawned upon our left in a frightful manner — more terrible in its semi-obscurity than it is possible to convey an impression of — until the danger was over, and we all stood safely upon the Grand Plateau about half-past three in the morning.

We had now two or three miles of level walking before us. In single file we set off again, and the effect of our silent march was now unearthly and solemn to a degree that was almost painfully impressive. Mere atoms in this wilderness of perpetual frost, we were slowly advancing over the vast plain — slowly following each other on the track which the leading glimmering dot of light aided the guide to select. The reflected moonlight from the Dôme du Goûté, which looked like a huge mountain of frosted silver, threw a cold gleam over the plateau, sufficient to show its immense and ghastly space. High up on our right was the summit of Mont Blanc, apparently as close and as inaccessible as ever; and immediately on our left was the appalling gulf, yawning in the ice of unknown depth, into which the avalanche swept Dr. Hamel's guides in 1820.

Although physically the easiest, this was the most treacherous part of the entire ascent. A flake of snow or a chip of ice, whirled by the wind from the summit, and increasing as it rolled down the top of the mountain, might at length thunder on to our path and sweep everything before it into the crevice. Everybody was aware of this, and for three quarters of an hour we kept trudging hurriedly forward, scarcely daring to speak, and every now and then looking up with distrust at the "callotte," as the summit is termed, that rose above us in such cold and deceitful tranquillity. Once

or twice in my life I have been placed in circumstances of the greatest peril, and I now experienced the same dead calm in which my feelings always were sunk on these occasions. I knew that every step we took was gained from the chance of a horrible death, and yet the only thing that actually distressed me was that the two front lanterns would not keep the same distance from one another — a matter of the most utter unimportance to everybody.

At last we got under the shelter of the Rochers Rouges, and then we were in comparative safety, since, were an avalanche to fall, they would turn its course on to the plateau we had just quitted.

As we reached the almost perpendicular wall of ice below the Rochers Rouges, we came into the full moonlight, and, at the same time, far away on the horizon, the red glow of daybreak was gradually tinging the sky, and bringing the higher and more distant mountains into relief. The union of these two effects of light was very strange. At first simply cold and bewildering, it had nothing of the sunset glories of the Grands Mulets; but after a time, when peak after peak rose out from the gloomy world below, the spectacle was magnificent. In the dark, boundless space a small speck of light would suddenly appear, growing larger and larger, until it took the palpable form of a mountain-top. While this was going on, other points would brighten, here and there, and increase in the same manner; then a silvery gleam would mark the position of a lake reflecting the sky — it was that of Geneva — until the gray, hazy ocean lighted up into the hills, and valleys, and irregularities, and the entire world below warmed into the glow of sunrise.

It was now fearfully cold, and every now and then a sharp northeast wind nearly cut us into pieces, bringing with it a storm of spiculæ of ice, which were really very painful as they blew against and past our faces and ears; so we took to our veils again, which all night long had been twisted round our hats. I felt very chilled and dispirited. I had now passed two nights without sleep, and I had really eaten nothing since the yesterday's morning but part of an egg, a piece of fowl, and a little bit of bread — for my illness had taken away all my appetite, and on this small diet I had been undergoing the greatest work. But none of us were complaining of nausea, or difficulty of breathing, or blood to the head, or any of the other symptoms which appear to have attacked most persons even on the Grand Plateau; so I plucked up fresh courage, and prepared for our next achievement.

This was no light affair. From the foot of the Rochers Rouges there runs a huge and slanting buttress of ice, round which we had to climb from the northeast to the east. Its surface was at an angle of about sixty degrees. Above us it terminated in a mighty cliff, entirely covered with icicles of marvelous length and beauty ; below, it was impossible to see where it went, for it finished suddenly on an edge, which was believed to be the border of a great crevice. Along this we now had to go, and the journey was as hazardous a one as a man might make along a barn-top with frozen snow on it. Jean Carrier went first, with his ax, and very cautiously cut every step in which we were to place our feet in the ice. It is difficult at times to walk along ice on a level; but when that ice is tilted up more than halfway towards the perpendicular, with a fathomless termination below, and no more foot and hand-hold afforded than can be chipped out, it becomes a nervous affair enough. The cords came into requisition again, and we went along, leaning very much over to our right, and, I must say, paying little attention to our guides, who were continually pointing out spots for us to admire — the Jardin, Monte Rosa, and the Col du Géant — as they became visible. It took us nearly half an hour to creep round this hazardous slope, and then we came once more upon a vast undulating field of ice, looking straight down the Glacier du Tacul, towards the upper part of the Mer de Glace.

Now the most really dangerous part of the whole ascent had arrived. The risk called for the strongest mental effort; and, with sense enough to see that our success in scaling this awful precipice was entirely dependent upon "pluck," I got ready for the climb. I have said the Mur de la Côte is some hundred feet high, and is an all but perpendicular iceberg. At one point you can reach it from

the snow, but immediately after you begin to ascend it obliquely, there is nothing below but a chasm in the ice more frightful than anything yet passed. Should the foot slip, or the baton give way, there is no chance for life — you would glide like lightning from one frozen crag to another, and finally be dashed to pieces, hundreds and hundreds of feet below in the horrible depth of the glacier. Were it in the valley, simply rising up from the glacier moraine, its ascent would require great nerve and caution; but here, placed fourteen thousand feet above the level of the sea, terminating in an icy abyss so deep that the bottom is lost in obscurity; exposed, in a highly rarefied atmosphere, to a wind cold and violent beyond all conception; assailed, with muscular powers already taxed far beyond their strength, and nerves shaken by constantly increasing excitement and want of rest — with blood-shot eyes, and raging thirst, and a pulse leaping rather than beating — with all this, it may be imagined that the frightful Mur de la Côte calls for more than ordinary determination to mount it.

Of course, every footstep had to be cut with the adzes, and my blood ran colder still as I saw the first guides creeping like flies upon its smooth surface. The two Tairraz were in front of me, with the forepart of the rope, and François Favret, I think, behind. I scarcely know what our relative positions were, for we had not spoken much to one another for the last hour; every word was an exertion, and our attention was solely confined to our own progress. In spite of all my exertions, my confusion of ideas and extraordinary drowsiness increased to such a painful degree that, clinging to the hand-holes made in the ice, and surrounded by all this horror, I do believe, if we had halted on our climb for a minute, I should have gone off asleep. But there was no pause. We kept progressing, very slowly, indeed, but still going on — and up so steep a path that I had to wait until the guide before me removed his foot before I could put my hand into the notch. I looked down below two or three times, but was not at all giddy, although the depth lost itself in the blue haze.

For upward of half an hour we kept on slowly mounting this iceberg, until we reached the foot of the last ascent — the "calotte," as it is called — the "cap" of Mont Blanc. The danger was now over, but not the labor, for this dome of ice was difficult to mount. The ax was again in requisition, and everybody was so "blown," in common parlance, that we had to stop every three or four minutes. I was perfectly done up, stumbling about as though completely intoxicated. Gradually our speed increased, until I was scrambling almost on my hands and knees; and then, as I found

SCALING THE MUR DE LA CÔTE

myself on a level, it suddenly stopped. I looked round, and saw there was nothing higher. The batons were stuck in the snow, and the guides were grouped about, some lying down, and others standing in little parties. I was on the top of Mont Blanc!

The ardent wish of years was gratified; but I was so completely exhausted, that, without looking round me, I fell down upon the snow, and was asleep in an instant. I never knew the charm before of that mysterious and brief repose, which ancient people term "forty winks." Six or seven minutes of dead slumber was enough to restore the balance of my ideas, and when Tairraz awoke me I was once more perfectly myself. And now I entered into the full delight that the consciousness of our success brought with it.

We all shook each other by the hand, and laughed at such small pleasantries so heartily that it was quite diverting. We had beheld all the wonders and horrors of the glacier world in their wildest features; we had gazed on scenery of such fantastic yet magnificent nature as we might not hope to see again; we had labored with all the nerve and energy we could command to achieve a work of downright unceasing danger and difficulty, which not more

THE SLIDE DOWN

than one half of those who try are able to accomplish — and we had succeeded.

THE FUN AND PERIL OF COMING DOWN

We left the summit at half-past nine, having been there exactly half an hour. We learned afterwards that we had been seen from Chamouni by telescopes, and that the people there had fired cannon when they perceived us on the summit; but these we did not hear. We were about three hours and a half getting back to the Grands Mulets, and, with the exception of the Mur de la Côte (which required the same caution as in coming up), the descent was a matter of great amusement. Sliding, tumbling, and staggering about, setting all the zigzags at defiance, and making direct short cuts from one to the other — sitting down at the top of the snow slopes, and launching ourselves off, feet first, until, not very clever at self-guidance, we turned right round and were stopped by our own heads — all this was capital fun.

After a time, as we descended, the progress became very troublesome, for the snow was beginning to thaw in the sun, and we went up to our knees at every step. Everybody chose his own route, and glissaded, or skated, or rolled down, according to his fancy. The sun was very bright and warm — we were all very cheerful and merry — and, although I had not had any sleep for two nights, I contrived to keep up tolerably well with the foremost.

THE MOST DANGEROUS EXPERIENCE OF THE WHOLE ADVENTURE

At one o'clock in the afternoon we got back to our old bivouac on the Grands Mulets. The heat of the rock was so stifling that we could scarcely support it, and Tairraz announced that the glacier was becoming so dangerous to traverse, from the melting of the snow, that even now it would be a matter of some risk to cross it. So we hastily finished our scraps of refreshment, and then, making up our packs, bade good-by to the Grands Mulets.

In five minutes we found that, after all, the greatest danger of the undertaking was to come. The whole surface of the Glacier des Bossons had melted into perfect sludge; the ice-cliffs were dripping in the sun, like the well at Knaresborough; every minute the bridges over the crevices were falling in, and we sank almost to our waists in the thawing snow at every step we took. I could see that the guides were uneasy. All the ropes came out again, and we were tied together in parties of three, about ten feet distant from one another. And now all the work of yesterday had to be done over again, with much more danger attached to it. From the state of the snow, the guides avowed that it was impossible to tell whether we should find firm standing on any arch we ar-

rived at, or go through it at once into some frightful chasm. They sounded every bridge we came to with their poles, and a shake of the head was always a signal for a detour. One or two of the tracks by which we had marched up yesterday had now disappeared altogether, and fresh ones had to be cautiously selected. We had one tolerably narrow escape. Tairraz, who preceded me, had jumped over a crevice, and upon the other side alighted on a mere bracket of snow, which directly gave way beneath him. With the squirrel-like rapid activity of the Chamouni guides, he whirled his baton round so as to cross the crevice, which was not very broad, but of unknown depth, transversely. This saved him, but the shock pulled me off my legs. Had he fallen, I must have followed him — since we were tied together — and the guide would have been dragged after me. I was more startled by this little accident than by any other occurrence during the journey.

At length, after much anxiety, we came to the moraine of the glacier, and I was not sorry to find myself standing upon a block of hard granite, for I honestly believe that our lives had not been worth a penny's purchase ever since we left the Grands Mulets. We had a

AT THE FOOT OF THE MOUNTAIN

long rest at the Pierre à l'Echelle, where we deposited our ladder for the next aspirants, and, in the absence of everything else, were content with a little water for refreshment. The cords were now untied, and we went on pleased, and, once more upon solid trustworthy ground, began the last descent.

We had heard the guns firing at Chamouni ever since we left the Pélerins; but as we entered the village we were greeted with a tremen-

THE RETURN TO THE HOTEL DE LONDRES, WITH ACCLAIMS OF VICTORY

dous round of Alpine artillery from the roof of the new Hotel Royal, and the garden and courtyard of the Hotel de Londres. The whole population was in the streets, and on the bridge, the ladies at the hotels waving their handkerchiefs, and the men cheering; and a harpist and a violin player now joined the cortège. When we got into the courtyard of our hotel we were invited to be gazed at and have our hands shaken by everybody.

I did not sleep very well when I went to bed that night. I was tumbling down precipices all night long, and so feverish that I drank off the entire contents of a large water-jug before morning. My face in addition gave me some pain, where the sun had caught it; otherwise I was perfectly well.

[The quaint old-style illustrations given above were made for the writer of the sketch, and follow closely the charming narrative. They serve, for one thing, to show the progress in the art of illustration in the past fifty years. Contrast them with the reproductions of mountain-climbing photographs and drawings in other parts of the volumes, and you will realize better the difference. Now, climbing parties go supplied with cameras and everything necessary to chronicle the experiences by the way.]

THIS INTERESTING MIDNIGHT VISITOR KNOCKED AT THE TENT IN A FRIENDLY WAY

LEAVES FROM AN ELEPHANT HUNTER'S JOURNAL

THRILLING ADVENTURES OF MR. G. P. SANDERSON IN INDIA, TOLD BY HIMSELF

WHO that has seen the wild elephant roaming his native jungles can deny that he is the king of beasts? Sir Samuel Baker says: "The king of beasts is generally acknowledged to be the lion; but no one who has seen a wild elephant can doubt for a moment that the title belongs to him in his own right. Lord of all created animals in might and sagacity, the elephant roams through his native forests. He browses upon the lofty branches, upturns young trees from sheer malice, and from plain to forest he stalks majestically at break of day, 'monarch of all he surveys.'"

A grander animated object than a wild elephant in full charge can hardly be imagined. The cocked ears and broad forehead present an immense frontage; the head is held high with the trunk curled between the tusks to be unfurled at the moment of attack; the massive forelegs come down with the force and regularity of ponderous machinery; and the whole figure is rapidly foreshortened and appears to double in size with each advancing stride. The trunk being curled and unable to emit any sound, the attack is made in silence, after the usual premonitory shriek, which adds to its impressiveness. A tiger's charge is an undignified display of arms, legs, and spluttering; the bison rushes blunderingly upon its foe; the bear's attack is despicable; but the wild elephant's onslaught is as dignified as it seems overwhelming. A large tusker's charge, where he has had sufficient distance to get into full swing, can only be compared to the steady and rapid advance of an engine on a line of rail. Elephant shooting may be pronounced to be the most dangerous of all sports, if fairly followed for a length of time. The danger, however, has this

charm, that though so great unless steadily and skillfully met, it is within the power of the sportsman, by coolness and nerve, to end it with a single shot.

A CURIOUS FACT ABOUT ELEPHANTS

One of the most remarkable facts in connection with elephants is the extreme rarity of any remains of dead ones being found in the jungles. Bones would not decay for some years, and teeth and tusks would survive for a long time, yet not a single pair of ivories has ever, as far as I know, been found in the Mysore jungles. The Singhalese believe that, on feeling the approach of dissolution, he repairs to a solitary valley and there resigns himself to death. This place is so mysteriously concealed that although everyone believes in its existence no one has ever seen it. One of the Kandyan chiefs assured me that it was the belief of his countrymen that when the elephant is about to die he turns to a valley near Adam's peak, reached by a narrow pass with walls of rock on either side, and that here, by the side of a lake of clear water, he takes his last repose.

A DESCRIPTION OF THE INDIAN ELEPHANT COUNTRY

The interior ranges as seen from Morlay present a splendid panorama of woods and open grass downs. The hills are rounded and all of about the same elevation. The woods are confined chiefly to the hollows where moisture favors their growth; the open downs between them are covered with dense lemon grass, which attains a height of eighteen feet. Between the Mysore range and the next range to the east lies a deep valley along which the Honhollay stream flows southward before its exit westward into open country. This deep forest-encumbered valley is a tract of great interest; and there are many places which I have penetrated where, I believe, other European foot never trod. Wild swamps there are where the strangest forms of vegetation are seen, some found nowhere else in the hills. The whole neighborhood has a weird character. Aged trees of huge dimensions, whose ponderous arms are clad with gray moss and ferns far out to their points — tough, gnarled, leafless creepers, as thick as a child's body, growing from one root, whither they mount the tall trees around, and thence spread like the arms of a cuttlefish in every direction, curling round some trunks, clearing long spans in places, and often extending for three hundred yards without varying much in thickness — make some of the chief features of the woods in these deep valleys. Few flowers are found. The whole is a damp, gloomy, hoary forest, sacred as it were to the first mysteries of nature. When any animals escaped us in the first range, or the lower jungles of the open country, and reached this haven, which is known as "Mullay Kardoo," or the Rain Forest, we generally had to abandon the chase, as it required a well-organized expedition to penetrate the tract.

HOW WILD ELEPHANTS ARE CAUGHT

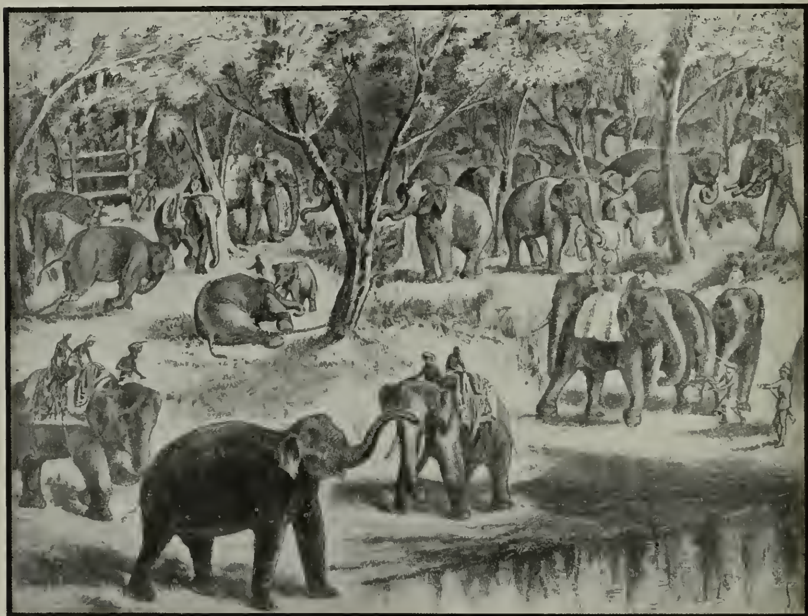
Few elephants are reared in captivity, the demand for the useful beast being met by the capture of wild herds. The usual method of procedure is not dissimilar from a cattle drive on our western prairies, but, needless to say, it is a far more hazardous enterprise.

A hunting party proceeds to the forest at the commencement of the dry weather — usually in December — equipped for two or three months, and the scouts having found a herd, the hunters are halted within a mile, when half of them file off to the right and half to the left. Along these diverging lines, which are to meet beyond the herd and inclose it, two men are left at every fifty yards or so, as a guard. The "surround," when completed, is often six or eight miles in circumference. It is a rule in elephant catching that this circle, being once completed, the herd can only escape through great carelessness on the part of the guard. In a couple of hours the hunters run up a thin fence of split bamboos all round the ring and make rough shelters of boughs for themselves. Their only duty then is to see that the elephants do not break out of the circle. The animals are seldom seen during the day, and at night large fires are kept up, and if they approach, shouts and shots are used to drive them back. Within this inclosure a "kheddah," or pound, is built of very strong posts about

twelve feet high, well braced, and with an entrance through which the herd is driven. Once inside this inner inclosure the entrance is secured and tame elephants are admitted with their drivers and rope-tiers. The tame elephants separate the wild ones one by one from their companions, when their hind legs are tied by the men, who slip to the ground for the purpose. They are then led out and picketed in the forest near by until they have been sufficiently subjugated to be removed.

ATTACKED BY A WILD ELEPHANT

As there were still some hours of daylight, the mahouts proposed to secure some of the captured elephants within the stockade, especially two or three that had given much trouble during the night. We therefore opened a gap in the stockade and took in six elephants, bareback, with a rope-tier holding the binding ropes seated behind each mahout. I rode the first elephant, a very fine and powerful female named Radhapeary. All catching elephants enjoy the sport of securing their wild companions, and Radhapeary trembled with eagerness as she stepped inside.



BINDING WILD ELEPHANTS IN THE INCLOSURE, WITH THE AID OF TAME ONES

Our six elephants formed abreast before the gap until it was securely closed again. A few of the wild elephants came forward to interview ours and touched them with their trunks. I was driving Radhapeary myself, sitting as mahout on her neck, with a rope-tier behind me. Some of the men had spears, but I had only the iron driving-goad in my hand.

We pushed our elephants on with the intention of cutting off some of the wild ones from the main body, and while doing this, I got in

advance, and became separated from the others. Some of the wild ones were rather impertinent, and each tame one was engaged in driving any back that opposed it, when I heard a shout of "Sahib! Sahib!" from the men perched on the stockade, and on turning saw a large, wild female, an old, tall, raw-boned beast, coming straight at me from behind with her trunk curled and her head up. She was on my near side, and in another instant was upon me, but not before I had slipped around as far as possible to the far side of my elephant's neck, holding on with my left leg. I just had time to drive my goad into her open mouth as she came down on my thigh with her jaws. She did not attempt to seize me with her trunk, but continued striking and attempting to bore me with her tushes. After boring for a second or two on my thigh, and upon Radhapeary's head, the elephant drew back, and I sat upright thankful for my escape, when, almost before I became aware of her intention, the fiend came straight at me again. Again I went over to the far side, and again my left thigh received a severe pummeling. Again I recovered myself, and yet again the infuriated beast rushed to the attack, repeating the former tactics. By this time blood was flowing from Radhapeary's head. My breeches and shirt had been torn to rags and I believed that my left leg was broken. I had hardly a moment's time for thought, however, for I perceived that she was about to renew the attack. I now felt that I was doomed. The invariable method of attack among female elephants is to press their chins upon the back of their opponent's head until the latter is forced by the pain of the boring tushes to sink to its knees, when it is quickly trampled to death. I could not expect to escape many more such attacks, and I calculated the chances against myself with a shudder. I was in the midst of wild elephants, and to slip or be thrown to the ground meant instant death. Radhapeary, all this time, was warding off the attacks of a young tusker, which occupied all of her attention. Could she have been free to attend to the female which was attacking me she would have made short work of her, for Radhapeary was a long, heavy, and powerful elephant of the highest caste of "koomeriahs" (thoroughbreds).

Forward once more went the wild elephant's ears. I grasped my goad. In a moment she was in her stride. At that instant a spear hissed by my head, striking her squarely in the temple, and in another instant Issamuttee, one of our elephants, struck her like a battering ram and almost knocked her over. I was saved just in time. The troublesome elephant, having been driven into a corner by the tame ones, was soon secured. When she was tied up, the mahouts begged to be allowed to thrash her well. That was quite a native's idea. I respected the poor beast for her courageous defense of her freedom, and forbade her being molested.

A MIDNIGHT VISITOR

On the night of the 27th of January, I was awakened by the sudden crash of an elephant just inside the cane jungle on the river bank within twenty yards of my tent. I jumped up, turned up my lantern, and held up the tent door. The light frightened the beast and it made off. The next night I was again awakened by an elephant, undoubtedly the same one, close at hand. I shouted at it as I lay in bed, but instead of making off I heard it step forward and seize my small bathing tent, which was about twenty yards away, and a tearing and flapping sound followed as the brute demolished it. I seized my rifle and threw up the tent door. I could see the white canvas being tossed up and down, but before I could distinguish the elephant in the darkness it dropped the tent and made off. It was about one o'clock, and I thought he might return. Accordingly I ordered two tame elephants to mount guard between my tent and the jungle. Nothing more was heard that night. The next night I redoubled my precautions. I had the jungle cleared away for sixty yards beyond my tent, which was nearer to the edge than any other. I then had two elephants picketed near the jungle, feeling certain that they would give notice of the approach of any wild elephant. I also had Radhapeary stationed close to my tent and six men told off as a night guard. After dinner I usually sat by a fire between my tent and the servant's, and to-night, while resting in this way, I heard an elephant squeak-

ing in the jungle about a quarter of a mile away. As the guard noted it also, I thought no more of it, but turned in.

I seemed to have slept for a long time when I was awakened by the tent just above my head and at the corner nearest the jungle being gently shaken. I thought of the rogue and was out of bed in a twinkling. The tent shook again very gently. I peeped through the door on the opposite side where the guard was. The old story! All still, the fire reduced to a few smoldering embers, the men lying in a row near it like corpses in a winding sheet, stark and still! Radhapeary was around my tent to the right, but I could not hear her moving. Just then the same gentle twang of the tent rope in the corner over my bed shook the tent and I heard an elephant breathe. I could hardly imagine that a wild elephant could be so near me, but I still hesitated to shout for fear of provoking an attack. However, as I heard nothing for a minute or two, I called Radhapeary gently by name, and was just going to open the door and look out cautiously when there was one ponderous step forward, a tremendous smash, cracking of ropes, and tearing of canvas. After the first crash the elephant drew back. The unexpected flood of light must have startled him, and, while I looked for a reappearance of his head, he was already making off. His attack on the tent was not prompted by viciousness but by the spirit of curiosity and mischievousness which are strongly marked characteristics of wild elephants and which lead them to upset telegraph poles, trample new road embankments, pull up survey pegs, and commit other similar depredations.

HUNTING A MAN-KILLER

One of the most useful lessons of the sportsman's pursuits is to teach him the value of perseverance. The successful hunter must always be a determined one. Another half-hour's pursuit has frequently changed what without it would have been a blank day into a red-letter one.

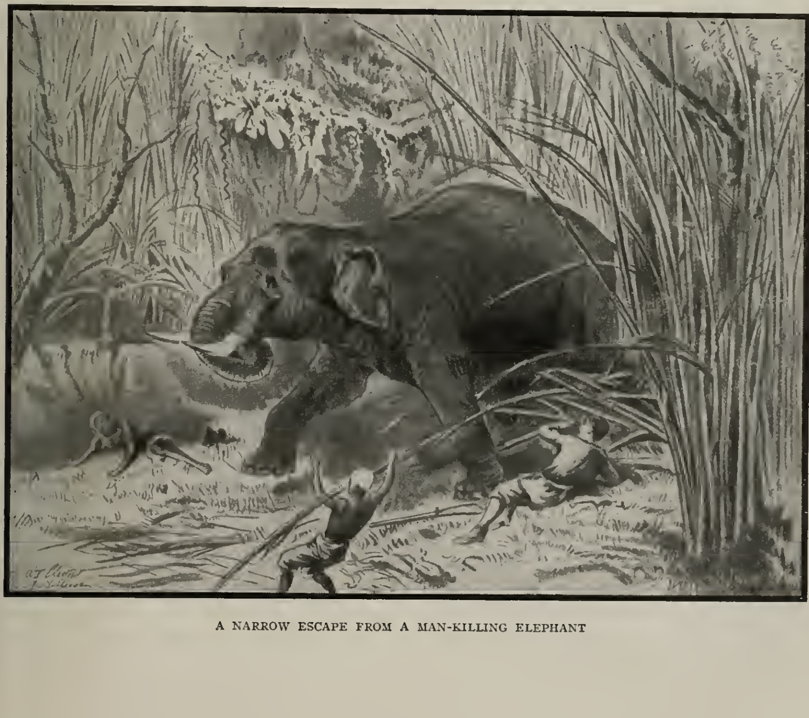
The next elephants I went after were four solitary animals, on different occasions, of which I bagged two and lost two. They were all individuals which were destructive to villagers' crops, and which I obtained permission to shoot whenever and wherever I met them. I then sallied forth after the Kakankote rogue, a really dangerous animal which had taken possession of about eight miles of the main road between Mysore and Wynaad. He at first did nothing more than alarm travelers by frequently appearing on the road. But after a time he took to chasing persons, and at last killed two men within a few days.

Kakankote is a small hamlet of half a dozen huts, forty-nine miles from Mysore, on the road to Wynaad. For sixteen miles the main road skirts the north bank of the Cubbany River through heavy forest. The jungle around is of teak and other large timber as well as bamboo. It is inhabited by the Kurrabas, a wild race, but first-rate assistants to the sportsman in search of big game.

The Kakankote rogue was well known to the Kurrabas by his large size and dark color and the upward curve of his sharp tusks. He had also lost more than half of his tail while fighting. On the day I arrived I dispatched two parties in search of him. The rogue was found to be within half a mile of a much frequented drinking pool and slowly feeding towards it. An hour before daylight news was brought in by two Kurrabas that he was feeding on their ragi crop in a clearing near the road. At daylight we set off and found that not only the rogue, but a muckna, or tuskless male, had been grazing about for some hours. About nine o'clock we came up to them. They had by that time located themselves in thick cover for the day. It would have been difficult for us to move about in such stuff and escape by flight if attacked there. After some recent unpleasant experiences, I thought it unadvisable to follow the pair into their stronghold, so we sat down to wait until they should quit it of their own accord. It began to rain heavily, and the noise made by the downpour on the broad leaves of the teak trees was so great that we could not hear the elephants breaking branches, though they were close at hand. We sheltered ourselves from the pouring storm as well as we could, cowering at the foot of a large tree and keeping a lookout lest the elephants should come in our direction.

At last the rain ceased, and wiping the rifles

dry we proceeded to look for the elephants' marks. They had fed close to us for some time during the rain, but had moved off two hours ago. After proceeding about a mile we heard the pair feeding in a hollow among thick bamboo cover, which hid them from view. The regular, slow, crunching sound made by their grinders as they chewed the tough wood and leaves was the only interruption, except the occasional crash of a bough, to the stillness of the dark and gloomy afternoon in the deep forest. The cover they were in was still too thick to be entered with any degree of safety, while the tusker's notoriety made us observe extra caution. We followed the slowly advancing pair, keeping parallel to them outside the cover in the open forest. At last they came near the edge and I saw their heads indistinctly among the bamboo fronds. Ordering the Kurrabas to keep behind a thick bamboo clump, I took my 4-bore rifle and crept forward to within thirty yards of the elephants. The muckna first passed slowly along, keeping inside the cover, and then the tusker. The latter gave me but an indistinct shot, which, however, I thought it advisable to take, as evening was drawing on. So I fired from a rest on a white ant hill behind which I knelt. The ground was wet and slippery, which rather delayed me in scrambling to my feet and getting back to the bamboo clump for my second rifle. I glanced over my shoulder as I reached its shelter. To my horror I saw both elephants behind me, their heads bobbing spasmodically at the great pace at which they were shuffling along. A race against an elephant is one which leaves no doubt as to the winner. Collaring my two gun carriers, Jaffer and Bettay, I pressed them close against the bamboo clump to prevent their moving and waited in breath-



A NARROW ESCAPE FROM A MAN-KILLING ELEPHANT

less anxiety. The Kurrabas had started off before the monsters, almost under their trunks, doubling like hares, without even looking behind. The elephants passed the bamboo clump like a pair of runaway locomotives. But they did not stop. Bettay said that it was because of some good deeds that he must have done in his former life. The next day we followed the tusker's track for many hours, but he had traveled rapidly, and evidently without being seriously affected by the shot. Elephants are rarely recovered when merely wounded by a head shot, and the sportsman

ONE ELEPHANT SUDDENLY FELL DOWN THE STEEP BANK

may usually spare himself the trouble of following them, as they will travel in one night a distance which will take him two days to cover.

RENEWING THE HUNT

Five months after I again found myself at Kakankote on a second campaign against the rogue. He had temporarily deserted the neighborhood, but had now returned, evidently not improved in temper, and had marked his arrival by killing a Kurraba, a relative of one of my trackers. The Kurraba was surprised when digging roots in the jungle. Two youths were with him, and it was after putting them up a tree and in attempting to follow that he was pulled down and torn limb from limb by the elephant. The Kurrabas who found the body said that the elephant had held the unfortunate man down with one foot while with his trunk he tore legs and arms from their sockets and threw them to a distance. We carried the track through open forests, bamboo covert, and long grass till noon, when we came regularly to fault, as the thickets we were now in had been much trampled by herd elephants, and the rogue had wandered from one path to another in a most puzzling way. I have much too great an opinion of the Kurrabas to suppose they would not have worked out the trail sooner or later, but at this moment the rogue relieved us of all further trouble as to tracking by trumpeting, or rather squeaking, in some high grass about two hundred yards back on the trail over which we had just come. Fortunately the wind was all right, and the squeak he now made was merely of caprice as he got on his legs after his midday snooze. When the rogue trumpeted my men were greatly excited. Here we were face to face with the man slayer! They could hardly speak. I gave them a minute or two to get cool, told them to stick close to me, and to mind not to clink the guns together, and then ordered the Kurrabas to advance.

We pushed through dangerously thick stuff, where I expected to hear the elephant's war trumpet every moment and to have him burst on us; but fortunately the wind was right and the unconscious monster stood quite unaware of the fact that enemies were near at hand.

We were within ten yards of him before we could make him out, and he then only appeared as a dark mass among the young bamboo and grass in which he was standing. There was a good breeze blowing, which made sufficient noise to cover our approach, but it was impossible to get near enough, even with this advantage, for the head shot in such thick stuff. Fearing that if I delayed any longer a slant of wind might betray us, I fired at where I knew his shoulder must be. The elephant remained motionless for an instant after receiving the shot, when with a wild scream and tremendous crash he went away, fortunately not in our direction.

As soon as I could reload we raced after him. The grass and bushes on both sides of his track were covered with blood, and my

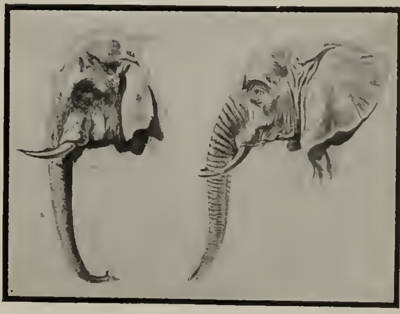
hands, face, and gun became sticky with it as we ran through the grass. We had only gone about two hundred yards when the Kurrabas stopped short, and with one word, "anay" (elephant), vanished. There was the elephant, sure enough, standing about twenty-five yards from us and facing us. He certainly was a sight to give a novice in elephant shooting a turn. Blood was gushing from his mouth, covering his chest, forelegs, and trunk. His twinkling eye showed that he meant mischief; his head was held high, his trunk curled between his tusks, and one foot was planted boldly in advance ready for a forward movement. Taking immediate advantage of his halt, I aimed between his eyes and dropped him dead on the spot.

AMUSING INCIDENTS OF ELEPHANT HUNTING

Our native doctor was very proud of his livestock, which consisted of eight ducks, and these he had secured, together with his cooking utensils and other household goods, on the back of Chumpa, a most tractable beast. Our way led along a narrow saddle, or ridge, exceedingly steep and covered with bamboo and the everlasting tall grass. At the worst part of the pass the ground suddenly gave way beneath Chumpa's feet and over and over she rolled to the bottom of the defile. It was a sight both terrible and comical to see the huge beast thus tossed about and struggling. Her mahout began to beat his mouth and wail that his elephant was dead. I comforted him by soundly boxing his ears, and climbing with great difficulty to the bottom of the ravine, found Chumpa perfectly calm and entirely uninjured, although it is doubtful if a man could have escaped with his life from such a tumble. The ducks left no trace large enough to enable anyone to state definitely what had become of them.

One remarkable incident that happened to me in the Kakankote jungles was the accidental shooting of an elephant in a pit. I was following a herd at the time and had sent two Kurrabas ahead on the trail, when one of them came running back, gesticulating frantically, and said an elephant had fallen into a pit and was just getting out. Away he went again, I trying in vain to understand from him what had happened, until he pointed ahead into the long grass and said, "There, there! Shoot him!" Not knowing what to make of this, except that there was an elephant somewhere in the grass, I ran on and almost fell into an old disused pit which now contained an elephant. As I stepped quickly back he threw his forefeet on to the bank and tried to reach me with his tusks. The whole incident was so sudden and unexpected and his rush so startling that I instinctively fired, severely wounding him and afterward put him to death. When life was entirely gone, one Kurraba, who was much afraid of elephants, peered into the pit with a nervous air which amused my gunners, and one of them gave him a sudden push into it and on to the elephant. The Kurraba's fear knew no bounds. He rushed at the most difficult side of the pit, screaming and leaping desperately, and when someone helped him out he ran at the top of his speed for a great distance.

I once found it necessary to send an old Sholaga tracker back to join the men with the pony, as he began to be troubled with a cough, which I knew from considerable experience with natives would break out at the most inopportune moment. I found out in other hunts that the old fellow was always similarly afflicted when we got near formidable game. As his duty was really over when he brought me and my gun-bearers up to game, I gave him standing permission to fall back before fighting commenced, which proved a complete cure for his malady.



AN INDIAN AND AN AFRICAN ELEPHANT'S HEAD

CHARGED BY A RHINOCEROS

THE rhinoceros of Cochin China is as fleet as he is fierce, and to his speed he adds enormous strength and a horn long enough and sharp enough to go straight through the body of a horse and pierce a man on the other side. The following experience with this dangerous antagonist befell a young lieutenant of the United States Navy.

His horse had suddenly gone lame and Lieutenant White, who had thus been obliged to fall out from a boar chase in which he had been engaged, was walking the animal back to the village from which he had started. On leaving the forest he came to a wide stretch of grass ground, skirted by a cane plantation, and dotted over with large wide-spreading bushes.

Soon he noticed that one of these bushes, which lay on his right front, was moving in a most unaccountable fashion; there was little wind, yet the bush rocked and heaved as though a storm was tearing at it.

The young officer turned to satisfy his curiosity, but his horse refused to obey and suddenly stood immovable, trembling violently. White used the spur gently. The horse snorted, but would not stir, and upon his bridle being sharply jerked broke out into a frightened neigh and the rider could see the sweat start from the withers of the terrified beast. Willing to humor him, he pulled the other rein, and the animal started forward at a brisk canter, quite forgetful of his legs.

Thus they came abreast of the moving bush about thirty yards from it, and White half reined up and turned to look at the cause of the mysterious motion. What he saw was a single-horned rhinoceros tearing at the bush as if in the wildest fury. Badly mounted as he was, the sailor had no desire for closer acquaintance with such a companion, and he gave the horse his head and the beast moved on at a smart gait. But the rhinoceros had either caught their wind or heard the beat of the horse's hoofs, for suddenly the lieutenant was conscious of a vibration of the ground, and turning saw the rhinoceros coming by a course that must cut him off from the road, and at a gait that could only be bested by a sound horse at full speed. No longer hesitating to use the spur, he worked his horse up to his best speed, but it was like turning up the wick of an exhausted lamp. The gallop endured for a minute, then the poor beast stumbled, slowed, and sweating at every pore, settled down to a despairing hobble, yet pricking up his ears and panting as the sound of the lumbering footsteps drew nearer. White had now rather more than half a minute in which to make up his mind as to his wisest course. His gun, loaded in both barrels, was slung across his shoulders, but he had had little experience in firing from horseback, and feared to risk the doubtful experiment. He must either leave the horse to its fate and rely upon his own speed and aim afoot, or he must face his pursuer and attempt to dodge the charge in the hope that after a failure or two the animal might desist and take itself off. Consideration for the horse led him to the second decision, and disregarding his beast's fright he swung him round on his haunches, and, standing up in his stirrups, awaited the rush of the rhinoceros.

It came quite soon enough, and it was only by tremendous effort that he managed to avoid it by a hand's breadth. But the savage animal was able to pull up and turn much more quickly than he had imagined to be possible, and he had scarcely swung his horse around a second time before the rhinoceros was on him again. This time the horse, dripping with lather, and fascinated by fear, could not or would not move. In vain the lieutenant drove the spurs into his flanks and, in his excitement and frenzy, beat him with his clinched fist on the side of the head. The poor wretch stood quivering till the horrible horn was within an inch of his chest. Then, too late, he rose shrieking on to his haunches. There was a ghastly, sickening concussion, and White, knowing too well what had happened, kicked his feet free of the stirrups and slid to the ground in a sitting position, the poor horse's death-scream ringing in his ears.

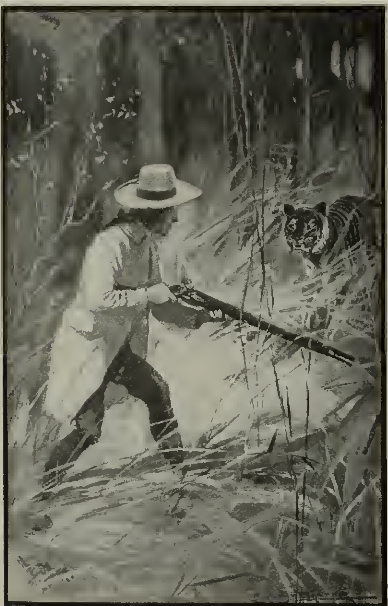
Stiff and aching, he struggled to his feet and snatched his gun just as the rhinoceros withdrew his bloody horn from the belly of the dead beast.

At that instant of extremest peril, all fear seemed to leave him, and a fury of anger took its place. He felt able and ready to enter into

TWO WAYS OF HUNTING TIGERS

Top: Tiger netting in Mysore, India. The natives surround the tigers with nets and then shoot or spear them. Bottom: A night watch. An animal is used as a decoy, and the hunter in the tree waits for the tiger. This is exciting sport.

a hand-to-hand struggle with the monster, and shouting at the top of his voice, "I 'll make you pay for this!" he pressed his gun almost against the vital spot just back of the shoulder and fired. Such a shot could not fail of its mission, and, bellowing with rage and pain and foaming at the mouth, the terrible beast fell over dead.



A TIME FOR QUICK ACTION

Wild beasts like the tiger and panther spring with a suddenness that leaves the hunter little time for careful preparation. This is one reason for the fascination the sport possesses for hunters of big game. Sometimes it is the hunted animal that gets the hunter instead of the hunter the animal.

THE TIGER'S CAVE

A GREAT tiger hunter, whose reputation is still on the lips of Englishmen and natives alike in India, is General, then Captain, Outram. Mr. George Vigne, the explorer, met him in the course of his travels and says of him: "He seldom went tiger hunting without incurring risks. I have known him to kill two tigers in twenty minutes. But if the great soldier carried daring to the verge of foolhardiness in his sports, he was also ready at need to save a fellow-man's life at the risk of his own."

He, Vigne, and a young lieutenant of Outram's regiment one day went tiger hunting on foot in the mountains. After half an hour of climbing, they came upon the footprints of the animal they sought, and, stalking him cautiously, at last they came in sight of him looking down at them from a well-wooded platform some distance higher. Vigne fired and missed, and the tiger took to his heels. But the three men lost no time in scrambling up to the level, and arrived there just in time to see the animal disappearing among the trees. Spurred by the excitement of the moment, they gave chase, and at length came in sight of the fleeing animal once more. He was running at a slightly less rapid pace than theirs and did not increase it when conscious of their presence.

"Slow up," whispered Outram, "he is making for that little cavern." The captain was right. The tiger bolted straight into a cave with an opening fifteen feet each way and, apparently, of considerable depth. Once inside he turned, and the hunters could see his eyes flashing green in the darkness.

At Outram's suggestion they took to the trees, the lieutenant climbing one and Outram and Vigne another.

"We shall get him if we have patience," said the captain. "Sit perfectly still."

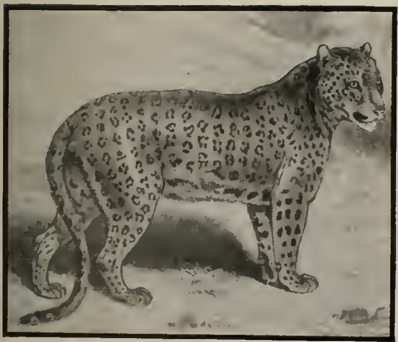
Dead silence is apt to play havoc with the nerves. Vigne had no watch, so he began to count the seconds, and had reached about six hundred, when there came a sudden noise that turned him sick with horror. It was the sharp, sinister crack of a breaking bough. The young lieutenant had chosen a branch that was weak and, without the least warning, it had snapped, dropping him heavily to the ground. He lay quite unconscious, not more than fifteen feet from the mouth of the cave.

Vigne thrust his head through the leaves to consult his friend by a look, and at the same moment an ominous growl and stir came from the cave. He saw Outram unsling his gun; then, apparently thinking better of it, put it

back again, and begin to swing himself to the ground.

"Come back, you must be mad!" gasped Vigne.

The moment his feet touched the ground, the captain had his gun in his hand again and in a couple of strides he was standing over the prostrate lad with the muzzle pointing at the cave. Vigne pulled himself together. "I 'll back you up," he cried, and prepared to descend. But at his shout the hidden tiger uttered an angry snarl and Vigne felt instinctively that the beast was springing. He was right. For a second a blurred yellow mass seemed to hang in the air, and while it was there both barrels of the old tiger hunter's gun went off. The beast was dead before he could fall, but the momentum of his spring carried him so far that he fell with his whole four hundred pounds within a few inches of the body of the now reviving subaltern.



THE PANTHER RANKS NEXT TO THE TIGER AMONG THE DANGEROUS BEASTS OF PREY OF INDIA

HAND TO HAND WITH A PANTHER

HOW A HUNTER RISKED HIS LIFE IN AN OPEN FIGHT WITH A DEADLY FOE

HAVING warned the village shikaree to keep close behind me with the heavy spear he had in his hand, I began to follow the wounded panther; but had scarcely gone twenty-five yards when one of the beaters, who was on high ground, beckoned to me and pointed a little below him and in front of me. There was the large panther sitting out unconcealed between two bushes a dozen yards before me. I could not, however, see his head; and while I was thus delayed, he came out with a roar, straight at me. I fired at his chest with a ball: and, as he sprang upon me, the shot-barrel was aimed at his head. In the next moment he seized my left arm and the gun. Thus, not being able to use the gun as a club, I forced it, cupwise, into his mouth. He bit the stock through in one place, and, while his upper fangs lacerated my arm and hand, the lower fangs went into the gun. His hind claws pierced my left thigh. He tried very hard to throw me over. In the meanwhile the shikaree, who, had he kept the spear before him, might have stopped the charge of the panther, had retreated some paces to the left. He now, instead of spearing the panther, shouted out and struck him, using the spear as a club. In a moment the animal was upon him, stripping him of my shikar-bag, his turban, my revolving rifle, and the spear. The man passed by me, holding his wounded arm.

The panther quietly crouched five paces in front of me. I knew my only chance was to keep my eye upon him. He sat with all my despoiled property, stripped from the shikaree, around and under him. The first step I moved backward, keeping my eye on the panther, I fell on my back into a thorn-bush, having slipped upon the rock. Here I was still within one spring of the animal, who appeared, as far as I could see, not at all disabled by the fight. Nothing could have saved me had he again attacked; "but there 's a sweet little cherub that sits up aloft" to look out for the life of the old hunter. I retreated step by step, my face still towards the foe, till I got to my horse and to the other beaters, who were all collected together some forty yards from the fight.

I immediately loaded the gun with a charge of shot and a bullet that I by chance found; and taking my revolver out of the holster and sticking it into my belt determined to carry on the affair to its issue, knowing how rarely men recover from such wounds as mine. I was bleeding profusely from large tooth wounds

in the arm; the tendons of my left hand were torn open, and I had five claw wounds in the thigh. The poor shikaree's arm was somewhat clawed up, and, if the panther was not killed, the superstition of the natives would go far to kill this man. Terribly frightened as he was, his wounds were not so bad as mine. I persuaded my horse-keeper to come with me; and taking the hog-spear he had in his hand we went to the spot where lay the weapons stripped from the shikaree. A few yards beyond them crouched the huge panther again. I could not see his head very distinctly, but fired deliberately behind his shoulder. In one moment he was again upon me. I gave him the charge of shot, as I supposed, in his face, but had no time to take aim. The horse-keeper, instead of spearing, fell upon his back. In the next instant the panther got hold of my left foot in his teeth, and threw me on my back. I struck at him with the empty gun, and he seized the barrels in his mouth. This was his last effort. I sprang up, and, seizing the spear from the horse-keeper, drove it with both hands through his side, and thus killed him. I immediately had my boot pulled off. My foot bled profusely. Fortunately, the wound was in the thin part of the foot, and not in the instep or ankle; but the teeth had met.

A NARROW ESCAPE

The hero of the foregoing adventure was Captain Shakespeare, who has a multitude of such stories in his interesting book on Indian sport; the following, however, sufficiently proves that the African panther can, on emergency, be quite as ferocious as his Asiatic cousin:

A French gentleman well known in Algiers, who is passionately fond of panther hunting, Monsieur Bombonelle, lately set out in the evening, according to his custom, to pursue his favorite sport. The hunter was accompanied by some Arabs, who carried a live she-goat. When they arrived at a selected spot, the goat was tethered to a stake fixed in the ground and the huntsman concealed himself in a hole in the earth, with the goat's kid in his arms. A few pinches administered to the kid soon reacted upon the goat, who began to bleat frantically. This presently brought down the panther, who hunts entirely by sight and sound. On the evening in question the panther happened to be close at hand, and made his appearance before the Arabs had completed their preparations. In the hot haste of their flight they neglected to drive the post to which the goat was fastened firmly into the ground. The panther, having secured his easy prize, was making off without loss of time, when Bombonelle, afraid of losing altogether his night's sport, fired in a hurry and broke the beast's forelegs.

The animal lay for a few moments as if dead. The huntsman incautiously approached; the beast immediately sprang at him, and the second barrel missing fire the panther caught him by the cheek. The animal's teeth, however, slipped through the flesh. At a second dash the man's forehead was grasped, the end of his nose bitten off, and his cheek fearfully lacerated. In its third spring the panther caught him by the turban. Out of this Bombonelle managed to extricate his head, and the animal rolled down the side of the hill on which they were fortunately lying. The panther's forelegs being broken, he could not climb the hill again. Another fortunate circumstance was that the panther had been placed across the man. If it had been otherwise, and the animal had obtained a purchase with his hind legs on the man's body, the result would have been fatal. When the Arabs returned to the spot in the morning they found the panther dead at the bottom of the hill and the Frenchman, numbed and senseless from the loss of blood, at the top. The sportsman was carried into Algiers in such a state that none of his friends could recognize him. His doctor made a very good cure of it; and by judicious application of caustic his beauty was said not only to be restored, but increased. He shot another panther near the same spot three months afterwards.

THE MYSTERIOUS CITY OF LHASSA IN TIBET

TORTURED IN TIBET

WHAT HAPPENED TO THE FIRST EUROPEAN WHO PENETRATED THE "FORBIDDEN LAND"

IT was in 1897 that the English traveler, A. Henry Savage Landor, accomplished the perilous feat of entering the sacred city of the Grand Lama of Tibet. For centuries this had been known as "The Forbidden Land." His book entitled "In the Forbidden Land," published (in 1899) by William Heinemann, London, tells of his strange experiences and terrible sufferings, which almost pass belief. Lovers of courage, coolness, and adventure will find this story one of thrilling interest. We condense and adapt one of the most exciting experiences.

Having penetrated to the Maium Pass (between Burma and Tibet) after much exertion and many hardships, there stretched before him the "sacred" country and "holy" city of Lhassa. He had taken a scouting trip and returned to his men on the Pass when a number of Tibetan soldiers rode up, and pointing to the valley beyond the Pass the leader cried, "That yonder is the Lhassa territory, and we forbid you to enter it." Taking no notice of this, and driving before him the two yaks loaded with baggage, the adventurer passed into the most sacred of all sacred provinces, called the "ground of God" by the Tibetans. His plan was to proceed within a few miles of Lhassa, hide his two men there, dress in a disguise, and go alone at night into the city, which has no gates and only a ruined wall around it.

A TREACHEROUS ATTACK

His troubles began when a number of Tibetans came to sell him provisions and ponies. Chanden Sing and Mansing, his servants, were much delighted at the prospect of getting good ponies. They tried first one and then another, and at length asked him to try one. Unsuspicious of foul play, as it would be hard to try the lively ponies with his rifle slung over his shoulder, he walked unarmed to the spot. No sooner had he stooped to examine the pony's forelegs than he was suddenly seized from behind by several persons, who grabbed him by the neck, wrists, and legs, and threw him down on his face. He struggled and fought until he shook off some of his assailants, but others rushed up. He held them in check until long ropes were thrown at him from the sides like lassos, and entangled him. One rope twisted about his neck and completed their victory. They pulled hard at it from the two ends, and, while he panted and gasped and fought, they tugged and tugged to strangle him, till he felt as if his eyes would shoot

out of their sockets, and seemed to be suffocating. They dragged him to the ground, and stamped and trampled upon him with their heavy-nailed boots until he was stunned. Then they tied his wrists tightly behind his back, and bound his elbows, chest, neck, and ankles. Having bound the servants in the same way, they tied the ropes that were around the necks of the prisoners to the pummels of their saddles, loosed their victims' feet, and rode off with them, firing their matchlocks in the air, shouting, hissing, and otherwise indicating victory. Thus the traveler made entrance into the Tibetan settlement.

LED OUT TO THE TORTURE

Early in the afternoon a soldier entered the tent where the Englishman was confined, and, striking him on the shoulder with a heavy hand, shouted: "*Ohe!*" (Tibetan exclamation, corresponding to "Look here!") Before the sun goes down you will be flogged, both your legs will be broken, they will burn out your eyes, and then they will cut off your head." The man, who seemed to be quite in earnest, accompanied each sentence with a motion illustrating his words. The prisoner laughed at him and affected to treat it as a joke. He knew better, however, and presently the Rupun approached with a number of soldiers, and had a private conference with him. The officer seemed depressed, and his face was of a ghastly yellow. He laid his forehead upon Landor's in sign of compassion, and sadly shook his head. "There is no more hope. Your head will be cut off to-night. The Lamas are bad and my heart is aching." He was plainly suffering, but unable to control the situation.

TOBOGGANING YAK

THE SPIKED SADDLE AND RED-HOT IRON

The captive was compelled to witness the horrible torture of one of his servants, and was then taken away to meet his own fate. He gives a graphic description of the experiences which followed. First, he was thrown upon a saddle with a very high-backed wooden frame, from the back of which five or six sharp iron spikes stuck out horizontally. As he sat on this implement of torture the spikes caught him in the small of the back. With a large guard, they set off at a furious pace, his pony being led by a horseman riding in front. Thus they traveled across the country for miles, until they arrived at a spot where a cavalcade was drawn up in line. There were about a hundred red Lamas in the center, with banner men whose heads were covered by flat, fluffy hats, and as many more soldiers and officers in gray, red, and black tunics — some two hundred horsemen in all. The Pombo, in his yellow coat and trousers and queer pointed hat, sat on a magnificent pony a little in front of the crowd of Lamas and soldiers.

Curiously enough, when close to this new crowd, the horseman who led Mr. Landor's pony let go the rope, and the pony was lashed cruelly and left to its own devices. The soldiers of the guard reined up and drew aside. The pony dashed off in the direction of the

Pombo, and, as it passed close to him, a soldier knelt down, and, taking aim with his matchlock resting on its prop, deliberately fired at the prisoner. Although this was one of the champion shots in the country, and the distance from the muzzle of his matchlock to the victim not more than four yards, the bullet missed him, whizzing past his left ear. Probably the speed at which the pony was going saved him; but the pony, startled at the sudden report of the matchlock at such close quarters, began rearing and plunging. He managed to keep his seat, though the spikes in the saddle were tearing terribly the lower part of his spine.

RIDING A SPIKED SADDLE — AN ALMOST INCREDIBLE STORY

Two or three men then tore him from the saddle. He asked for a moment's rest, but the captors refused, and thrusting him forward said he would be beheaded in an instant. All the people around him jeered and made signs that his head would be cut off, and insults of all kinds were showered upon him by the crowd of Lamas and soldiers. He was hustled to the execution ground, which lay to the left front of the tent. On the ground was a log of wood in the shape of a prism. Upon the sharp edge of this he was made to stand, and several men held him by the body, while four or five others, using their combined strength, stretched his legs as wide apart as they would go. Fixed in this painful position, the brutes securely tied him by his feet to the log of wood with cords of yak hair. When thus firmly bound, one ruffian came forward and seized him from behind by the hair of his head. The spectacle before him was overwhelming. By the Pombo's tent stood in a row the most villainous brutes he had ever set eyes upon. One, a powerful, repulsive individual, held in his hand a great knobbed mallet, used for breaking bones; another carried a bow and arrows; a third held a big, two-handed sword; while others made a display of various ghastly instruments of torture. A bar of iron with a handle of wood bound in red cloth was being made red hot in a brazier. The Pombo placed something in his mouth to make him foam at the lips. A Lama handed him the now red-hot iron, and the Pombo seized it by

the handle. He strode up to the prisoner, brandishing the ghastly implement. He seemed reluctant, but the Lamas around him urged him on.

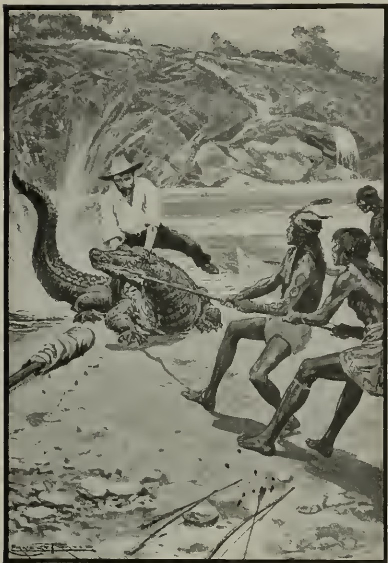
"You have come to this country to see. This then is the punishment for you," and with these dreadful words the Pombo raised his arm and placed the red-hot iron bar parallel to and about an inch or two from Mr. Landor's eyeballs, and all but touching the nose. He says: "Though the time was probably not more than thirty seconds, yet it was quite long enough. When I lifted my aching eyelids, I saw everything as in a red mist. My left eye was frightfully painful, and every few seconds it seemed as if something in front of it kept me from seeing. With my right eye I could still see a little, except that everything looked red.

"A matchlock was now placed against my forehead, but with the muzzle pointing upward. Then a soldier, leaning down, applied fire to the fuse, and eventually there was a loud report, which gave my head a severe shock, and the overloaded matchlock flew clean out of the Pombo's hands, much to everybody's surprise. I forced myself to laugh; and their confusion, added to the failure of every attempt to hurt me, drove the crowd to the highest pitch of fury. 'Kill him, kill him!' exclaimed fierce voices all around me. 'We cannot frighten him, kill him!' The whole valley resounded with these ferocious cries. A huge, two-handed sword was now handed to the Pombo, who drew it out of its sheath. At this point a Lama approached and slipped something into the mouth of the executioner, which again made him foam at the lips. Another Lama held his sword while he rolled up his sleeves. Then he strode towards me with slow, ponderous steps, swinging his shiny blade from side to side before him, with his bare arms outstretched. The man who was still holding my hair was told to make me bend my neck. I resisted with what little strength I had. The executioner, now close to me, held the sword with his nervous hands, lifting it high above his shoulder. He then brought it down to my neck, which he touched with the blade to measure the distance for a clean, effective stroke. Then drawing back a step, he quickly raised the sword again and struck a blow at me with all his might. The sword passed disagreeably near to my throat, under my chin, but did not touch me. I would not flinch nor speak, and this seemed to impress him almost to the point of frightening him. He did not seem to wish to try again, but the crowd and the Lamas nearest him urged him on. Apparently against his will the executioner went through the same kind of performance on the other side of my head. This time the blade passed so near that the point cannot have been more than half an inch from my neck. The Lamas were still calling for my head, but the Pombo made a firm stand and refused to go on with the execution. They collected around him and seemed very angry; they shouted and yelled and gesticulated in the wildest fashion, and still the Pombo kept his eyes upon me in a half-respectful, half-frightened manner, and refused to move."

After this series of brutal tortures, he was re-bound more severely than before, and thus left for the night. On the following day began a long consultation of their oracles, which was done in many strange ways, and particularly by the actions of a mesmerized man. At each trial it was decreed by the sacred signs that the prisoner must die. At that moment someone looked at Landor's hands. They were webbed between the fingers a little farther up than is usual. With the Tibetans a person so made is regarded as above the reach of death, and looked upon with much fear. And so, as the result of this man's chance glance, Landor's bonds were loosened, and a great entertainment was gotten up for his enjoyment, although in his condition he could scarcely see anything that was done. But his troubles were by no means over. He was ordered to leave the country, and a guard of soldiers was sent along to see that he did. These, although they did not dare to openly kill or do violence of any kind, had evidently received secret orders to cause his death if possible. As they neared the border, every kind of obstacle was placed in his way to prevent his actually crossing the line into British territory. At last word of his condition was carried to his friends, and by their assistance he was brought out of the country, more dead than alive, — the first European who ever penetrated to the Sacred City and returned alive.

SCENES FROM STORIES OF ADVENTURE IN STRANGE LANDS

1. Brought to bay. The kangaroo invariably tries to get his back to a tree or rock; and woe betide the unlucky dog which comes within reach of his formidable hind foot, for with one stroke he will rip up and kill him. 2. Hunting the rhinoceros. In Abyssinia two hunters, one armed with a spear, the other with a sword, are mounted on the same horse. The one with the spear goads the animal to charge, and as the huge brute thunders past, the man with the sword slips down and severs its hamstring. 3. A plucky sheikh. A lion seized and carried off a good-sized calf. A young sheikh, mounted on a mule, and armed with only a spear, followed, and transfixed the brute in mid-air as it was springing at him. 4. A cool huntress. The lady's first shot missed, but the second one wounded the leopard. The infuriated animal hurled himself like a shapeless cannon ball at the huntress, but missed his aim, and was then shot through the brain by the plucky little woman.



WATERTON TAKING AN ALLIGATOR ALIVE

RIDING AN ALLIGATOR

AN English naturalist, Charles Waterton, who traveled pretty much all over the world and collected all sorts of queer animals, once captured a cayman and rode him ashore, as this story will tell. It was disbelieved at first, but, after he had proved the truth of many adventures equally wonderful, people knew him to be truthful. The cayman is a kind of alligator, and a frightful creature to see, as well as most treacherous and dangerous to meet. He emits an awful sound, long-continued and penetrating, enough to make the hair stand on end, and a disgusting smell, almost unbearable. Waterton resolved to catch a live specimen, a proposal that staggered his negro attendants, and made the Indian hunters shrug their shoulders incredulously. But they did not know the naturalist. For several nights he made unsuccessful attempts to bait a cayman. The animal would take the bait into his huge mouth, but, when the men began to pull, would drop his mouthful and make off.

Four fruitless nights were spent, and yet the cayman was no nearer being caught than before; so the naturalist determined to try another plan, namely, call in some Indian hunters, whom, however, he had to bribe to undertake the business. They laughed at a shark hook he proposed to try, saying that such a thing would not hold the cayman. And this prediction proved true, for the brute came and took the hook into his mouth, but would not swallow it. The Indians now set about fashioning a contrivance of their own. It consisted of four stout pieces of wood, a foot long and barbed at both ends. These were fastened securely round a stout rope and baited.

This formidable apparatus was suspended in a suitable place, and the party went off to their hammocks and to sleep, the hook to be left till morning. Quite early, however, one of the Indians went silently to see how matters were progressing. A tremendous shout from him brought all the rest to the spot in the shortest possible time. Waterton stayed a couple of minutes to "don his trousers," he tells us; the Indians had none to don.

They found that a cayman had swallowed the huge barbed contrivance and some of the rope, and was fast enough. Waterton declared that he intended to get the brute out of the water alive, so that the hide should be uninjured, and thus have a perfect specimen. On this the Indians expressed the utmost astonishment and incredulity; they did more, they declined to assist in so hazardous a business, saying that the cayman would eat them all. They wanted to shoot the animal with arrows, but the Englishman would have none of it, as the skin would then be spoiled for his purpose. He rated the party for their cowardice. But not a man would stir to help.

In this pass, Waterton bethought him of another device. Taking the mast of the canoe, a pole eight feet long and the thickness of a man's wrist, he tied the sail round the end of it. Then, dropping on one knee, he held the pole before him as a soldier holds his bayonet, intending to thrust the thing down the cayman's throat, should the brute in his fury rush out

upon him. He held in readiness also a formidable knife. His men, seven in number, were now told off to pull at the rope and thus drag the animal fairly out of the water, a task the fellows undertook in fear and trembling, being reconciled to the position only by the fact that the master was between them and the danger. They were instructed to slacken the rope at once should the animal begin to plunge.

The pull began, and the cayman was compelled to show his face above water, an ugly sight to the man kneeling there in front of him. But the beast plunged so desperately that the rope had to be slackened. Another try, this time the men being told to pull, whatever happened, till they had the brute out of the water. For an instant, the naturalist stood in front, gazing steadfastly into the cayman's eye. He could see the animal was afraid of him.

Now comes the extraordinary part of the tale. Suddenly throwing down his pole, Waterton sprang on the animal's back, turning in his spring so that when seated he had his face towards the head. Then, with wonderful pluck and dexterity, he seized the fore legs and brought them up over the back and held them tight in that position.

The beast had been dazed at first, but now he came to himself, and at once made the most desperate efforts to escape and to attack his captor. His tail lashed violently, but could not reach to do any harm to the rider; the plungings of the victim, however, made that rider's seat anything but an easy one. The fellows now cheered and roared with delight, pulling stoutly and drawing the cayman and Waterton over the sand, till a distance of forty yards had been covered. But what if the rope had broken under the strain? As the naturalist says, "There would have been every chance of going down to the regions under water with the cayman."

The brute's struggles at length exhausted it, and then the victor coolly proceeded to tie up its jaws and fasten its fore legs in the position in which they had been held for the ride. After another severe struggle the animal was taken to the canoe, and thence to the settlement, where it was killed.

WATERTON AND THE SNAKE

This naturalist seemed to have a strange immunity from injury from snakes. His coolness and courage in facing the most deadly reptiles was astounding. Here is a sample: Seeing a young snake of the coula-canara species (deadly poisonous) crawling along, he instantly dropped on one knee and seized the animal by the tail with one hand. Then, with his right holding out his hat as a sort of shield, he held himself in readiness. The snake, of course, darted its head at him, opening its mouth and setting up a loud hissing. Waterton

AN INTERRUPTED BATH

waited till the brute's jaws were within a couple of feet of him, and then struck a violent blow with his hat-protected fist. For an instant the snake was stunned, and before it could recover itself the naturalist had it gripped fast by the throat, just below the head, so that

it was impossible for it to bite. The coulacanara wound itself round his arm and body, but was not strong enough to crush him. A negro attendant, who came up, attracted by the noise, turned almost sick at the sight, and made for home as fast as his legs could carry him.

Wishing to try an experiment, Waterton managed to catch alive a labarri, one of the deadliest of the snakes of the district. As usual, he gripped the animal so near the jaw that it was unable to bite him. To do this "only required a little resolution and coolness," he tells us. He then held a bit of stick to the head, and the brute seized it at once, the fang piercing the wood. The liquid that was squirted out through the hollow fang was of a deep yellow, something like strong camomile tea. This was the deadly poison. He forced the labarri to bite itself, and it buried its fang in its own body. In the course of a few minutes the snake appeared to be dying; then, strange to say, it began to recover. Soon it was not a whit the worse, and Waterton had proved that the reptile was proof against its own poison.

A COBRA AS A BED-FELLOW

HOW A ROBBER UNINTENTIONALLY BECAME A LIFE-SAVER

THE first feeling of the newcomer to India is that the whole country teems with snakes. Now, though the name of reptiles is legion, it is wonderful after all how few one really sees. Of course in the rainy season the poor snake is driven out of his hole by a sudden flood of water, and therefore naturally seeks a good dry shelter in your bungalow; or, if your curiosity leads you to make researches in old ruins, or on the marshy margins of "jelous" and "jheels" (tanks and swamps), you must expect to come across a good number of snakes of all kinds, whose retiring disposition and a desire for refreshing coolness lead them to choose spots far from those locations frequented by their enemy, man.

That there are many cases of death by snake bite in the various presidencies and provinces of India is undeniable; but in most cases the victims are natives, and when one considers that in their own hovels they entirely dispense with shoes, and that their drapery is often of the scantiest, this is hardly to be wondered at. Sometimes, however, a snake claims an unpleasantly close acquaintance with you, and insists upon thrusting his company upon you in a most undesirable manner; but yet, after all, a visit of this kind *may* have its advantages, as the following story will show:

"Some years ago, long before the 'iron horse' was an acknowledged fact in the East," says Sir Gilbert E. Campbell, "I had occasion to make the journey from Wassind to Mhow. It was the rainy season, and traveling was most unpleasant; but necessity knows no law, so with some grumbling I packed myself into a 'gharry,' which, for the sake of the uninitiated, I may describe as a sort of two-wheeled omnibus drawn by bullocks, and started on my journey. And a toilsome journey it proved to be, and by the time I got to Egutpoora, at the top of the Ghauts, what with damp, bad bullocks, slow traveling, and general want of rest, I was so feverish and done up that I felt I must have a good night's rest, though the delay might prove most injurious to the important business upon which I was traveling. I accordingly quitted my gharry at the Egutpoora Dâk bungalow, and, calling the Khansamah in charge, prepared to pass the night there.

"Dâk bungalows have often been described, and that at Egutpoora was not different from the rest of them. My apartments consisted of a high white-washed room, with the inevitable punkah slung from the ceiling, two rickety chairs, a shaky table, and a 'charpoy,' or bedstead; there was a very dirty blue and white carpet upon the floor, and a narrow door led into the bathroom attached to each apartment. Do not run away with the idea that a bathroom in India resembles 'the well-fitted bathroom with hot and cold water' that one hears of at home. In India the bathroom is simply a small closet with a flooring of hard cement, and the fittings consist of four or five large earthen pots full of water, and a hole in

the wall for the water to escape through. To my inquiries for dinner, the Khansamah, as usual, told me that I could have anything I liked, which, on cross-examination, as it always does, turned out to mean a fowl, and shortly afterwards I heard the doomed biped being chased about the premises by the whole strength of the establishment, preparatory to its being converted into cutlets for my evening meal.

"I was dead tired, and while my dinner was being prepared was glad enough to lie down and be free, for a short time, from the rumbling and creaking of the vehicle in which I had been so long imprisoned. My bearer, who was arranging my boxes, proceeded to entertain me with the news that he had gleaned from the Khansamah of the bungalow; but this was of the scantiest kind, the chief item being the daring and impudence of the Bheels, a tribe who live openly by plunder in all its various branches, and who had lately been more than usually audacious in their exploits. I listened to his chatter with a sort of dreamy indifference, for the sense of rest that was stealing over me was too exquisite to be lightly disturbed by such trivial matters, and even when dinner was announced I hardly felt inclined to rise and partake of it; and when I did I was sorry that I had done so, for, like most Dâk bungalow meals, it was curiously unpalatable. However, a bottle of beer, a glass of brandy-pâni, and a cheroot made me feel a little better; but, as I had determined to have a good night's rest, I speedily prepared for bed, and in a few minutes more was fast asleep.

"I do not know how long I slept, but this I *do* know, that my dreams were most uneasy; hideous objects seemed to pass before my eyes, I was continually in the most dangerous and appalling situations, stairs that I endeavored to ascend seemed to crumble beneath my feet, and in short I went through all the most terrible phases of the nightmare; but, above everything, I seemed to feel a pressure upon my breast, a cold clammy weight that appeared to stifle me and to be crushing out my very existence. With a start, at last I awoke, but the instinct which prompted me at once to spring from my bed was checked by a sight of horror which was plainly visible to me by the faint light of the oil lamp which burnt in a far corner of the room. Rising from a mass of coils upon my chest were the flat head and gleaming eyes of a snake, while its quivering tongue vibrated within a few inches of my face.

"I saw at a glimpse what had occurred: the snake had crept into the bathroom through the aperture by which the water escaped; then, finding the door open, it had penetrated into my bedroom and had crept into my bed for the sake of the warmth. My sudden movement on awaking had no doubt disturbed the reptile, for the eyes gleamed angrily, the quivering of the tongue became more and more rapid, and a faint sibila-

SHOOTING A COBRA AT CLOSE RANGE

tion jarred upon my ears like a death knell. As an addition to my terrible position, I perceived a kind of hood round the snake's head gradually expand, and I knew that my terrible visitor was a cobra, a snake whose bite was inevitably fatal, usually in the course of twelve hours.

"Presently my immovable attitude seemed to calm the creature's angry temper; the tongue grew quieter, the hissing ceased, the cruel glitter in the eyes died out, and the hood almost dis-

appeared from view. My hair bristled, and the cold drops of perspiration stood upon my forehead, yet I did not dare move hand or foot, nor even utter a cry. The slightest movement upon my part would, I felt, surely cause those envenomed fangs to be driven into my flesh, and then I knew that no human aid could save me. My only chance was that, towards morning, the snake would leave his warm bed and seek some place of retirement during the light of day, but a movement upon my part, even the entrance of a person into the room, might precipitate matters and doom me to certain and inevitable death. For more than two hours I lay upon my bed of agony, while my terrible visitor slept peacefully; but I knew that any movement upon my part would wake him and that then the end was certain.

"Meanwhile the weight of the reptile upon my chest became nearly insupportable, and the acrid odor that emanated from it filled me with a feeling of loathing which I could hardly control. Nature could endure it no longer, my overtaxed senses gave way, and a swoon providentially prevented my intellect from sinking under this terrible ordeal. From this state of insensibility I was aroused by feeling a cold wind blowing upon my brow. For a moment I hoped that the snake was moving, but there he lay in the same position as before.

"At that instant, however, my eye was attracted by a diminutive human figure, stooping over one of my portmanteaus. The mystery of the rush of fresh air was explained; someone had made his way into my room, for the purpose of robbing me. As I gazed, my human visitant rose from his stooping position, and came towards my bed; by the nude form glistening with oil, and the glittering knife held between the teeth, I recognized in the intruder one of the predatory tribe of Bheels, who, entirely divested of clothes, and thickly smeared from head to foot with oil, frequently commit midnight robberies, it being impossible, owing to these precautions, to grasp or retain them. I could see that the Bheel's eye had been attracted by the rich silk 'rezai' (quilt) which covered my bed, and that he had determined to make it his prize. Very gently he laid hold of it and drew it towards him, but was evidently surprised at the unexpected weight.

"I, meanwhile, lay in the greatest mental agony, for it was most likely that the snake, in its anger at being disturbed, would vent its rage upon me. Determined, however, in carrying off his booty, the robber let go the end of the quilt, and moving up to the head of the bed placed his hand upon the very body of the cobra. Quickly as he withdrew it the reptile was aroused, and with a sharp hiss it struck him full in the face with its venomous fangs; with a cry of pain the robber reeled back; then his knife flashed in the air and the body of the snake rolled headless to the ground. Heedless of my presence as I sprang from my bed, he picked up the reptile's head, and, perceiving that he had been bitten by a cobra, calmly sat down upon the floor to await his fate.

"Meanwhile the servants, alarmed by my cries, had rushed in, and their first impulse was to secure the robber. Of this, however, there was no need; death had set its seal upon the unhappy man, and in less than twelve hours he was a corpse. It was many nights, however, before I could sleep comfortably, and I trust that I may never again be protected from a burglar by so terrible a visitor as an Indian cobra.

"But of all the adventures with snakes, one of the most appalling I ever remember to have heard of occurred to a friend of mine, Captain W. of the Madras Horse Artillery. Captain W. was stationed at St. Thomas's Mount, at that time the headquarters of the Madras Horse Artillery; he was living in a small bungalow with his wife and children, and Mrs. W. at this period was in extremely delicate health, so much so that the slightest excitement or fear was liable to bring on a series of fainting fits. On the day on which the event occurred which I am now relating, Captain W. chanced to be on main-guard duty; he was captain of the day, and, being obliged to visit the different guards at stated hours, he kept on his full-dress uniform, including his sword, throughout the day, for no one could tell the moment the brigadier might command his presence. Sitting down to dinner with his wife, they had just finished that repast, and the servant had cleared away the table, when suddenly down fell a huge cobra from the ceiling right upon the center of the table. Instantly recovering from the shock, it raised up its deadly hooded head and, hissing violently, rocked to and fro in front of the terrified lady, who had happily fainted away on the instant. The slightest movement

on her part would have been instant death, and the snake was narrowly watching for this movement to fly at its victim. As quick as thought the captain had unsheathed his sword, and the next instant the snake's head flew across the room. This was indeed presence of mind; but there is every reason to suppose that, quick as the action was, help would have come too late had not Mrs. W. providentially been too much paralyzed with fear to move or speak."

a great pagoda, or heathen temple, and there sat daily, ready to talk with all who came. So he went on for years without a single follower. The first one came in 1819. Many difficulties and dangers were experienced for some years, and in 1824 war broke out between England and Burma. This resulted for the Judsons in the narrow escape which is here described.

The Burmese were at first astounded at the white strangers' audacity in attacking Rangoon,

THE "CARAVAN," ON WHICH THE JUDSONS SAILED FROM SALEM, FEB. 19, 1812

IN A BURMESE PRISON

FEW stories have more romantic interest than that of Adoniram Judson, the first American missionary to Burma. It was in 1812 that he married Ann Hasseltine and sailed in the clipper *Caravan* from Salem for Calcutta, India. But the British government had little liking for missionaries at that time, and ordered the Judsons to leave on short notice. They sailed for Mauritius, and finally took ship for Rangoon, then a mere collection of wooden huts and pagodas. Alone in a land of strangers, no wonder if their spirits sank. But Judson never gave up. He had to devote some years to learning the difficult language, and had to make his own grammar and dictionary in Burmese. He built a bamboo shed with a thatched roof under the shadow of

and the only fears expressed at the palace in Ava were lest the English should escape before they could be captured as slaves. "Send to me," said one of the ladies of a Woongyee (or high official), "four white strangers to manage the affairs of my household, as I hear they are trustworthy." "And to me," said a gay young sprig of the palace, "six stout men to row my boat." The Burmese army went down the Irrawaddy in large, gilded boats to execute these orders, with warriors singing and dancing in high spirits. Few of them were destined to return home again.

As soon as the army was dispatched to Rangoon, suspicion fell upon the Americans of being spies of the English. This suspicion was increased by the fact that Dr. Judson had received sums of money through Mr. Gouger, an English resident. On the 8th of June, 1824,

ADONIRAM JUDSON

ANN HASSELTINE JUDSON

to Mrs. Judson's horror, a number of men rushed into their house, and one whose spotted face denoted him as the public executioner flung Mr. Judson on the floor and tied his arms tightly behind him. Mrs. Judson vainly offered money for his release. He was led away, she knew not where, and she was left, strictly guarded by ten men. Presently a native Christian came with the information that Mr. Judson had been conducted to the death-prison. On the payment of two hundred "tickals" of silver, Mrs. Judson was allowed a five minutes' conversation with her husband, who hobbled to the door of the prison; but she was soon forced away from him and ordered to depart. She then presented a petition to the Empress, but all the reply she obtained was, "He is not to be executed; let him remain where he is."

During the next seven months Mrs. Judson, with marvelous persistency, kept applying to one after another of the members of the government, being exposed to continual rebuffs and insults. On one occasion a Burmese grandee seized her silk umbrella, and, when she begged that he would at least give her a paper one instead, he replied that she was too thin to suffer sunstroke, and drove her away. She managed to communicate with her husband by writing on a flat cake and burying it in a bowl of rice, while he, in return, wrote on a piece of tile, on which, when wet with water, the writing became invisible, but when the tile was dry became legible. Afterwards she found it more feasible to write on a sheet of paper, which she then rolled up and inserted in the spout of a coffee-pot.

The news of the defeat of the Burmese army by the English, and of the advance of the latter, only made matters worse for the unfortunate prisoners. They were thrust inside the common prison, with five pairs of fetters each, and so crowded that there was not room to lie down. There were at one time a hundred prisoners in one room without a window for the admittance of air. At last Mrs. Judson received an order from the Governor of the city to remove Dr. Judson from the common prison into a little bamboo room, six feet long and four wide. Under the circumstances this seemed a great alleviation.

Soon, however, their sufferings recommenced. An official called the Pakan-woon came into power, and by his orders the prisoners were suddenly removed to a place called Oung-pen-la, with the intention of sacrificing them to secure the success of the Burmese army. One

morning, when Mrs. Judson had brought her husband's breakfast as usual, she was summoned to the Governor's, and detained a considerable time. On her return she found the little bamboo shed torn down and the prison empty. Wild with nameless anxiety she hurried back to the Governor, who declared he was ignorant of their fate. He only said in an ominous way, "You can do no more for your husband; take care of yourself."

The next day she obtained a pass from the government to follow Dr. Judson with her three-months-old infant and a faithful Bengalee servant. When she arrived at Oung-pen-la, ten miles off, she found him half-dead with suffering and fatigue, and his first words were, "Why have you come? I hoped you would not follow, for you cannot live here."

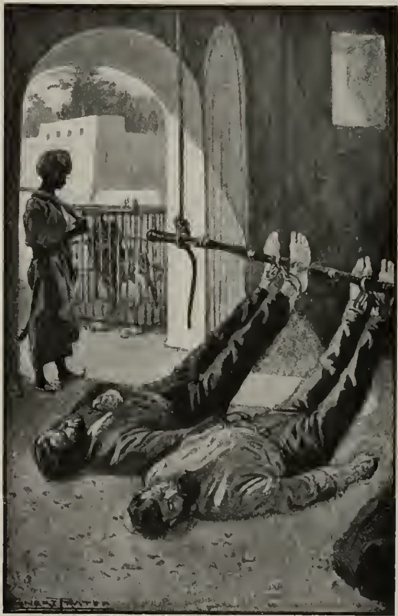
She learned that as soon as she had left him at the Governor's summons, one of the jailers had rushed into Mr. Judson's room, and stripped off his clothes, except his shirt and trousers. In this state the prisoners were driven, fastened by twos with ropes round their waists, under the burning tropical sun.

Dr. Judson's feet were lacerated by the stones and gravel. He obtained a little relief by leaning on the shoulder of his fellow-prisoner, Captain Laird, but the latter soon found the burden insupportable. So great was Dr. Judson's agony that on crossing a river he would have gladly flung himself into it had not the thought of the guilt of suicide prevented him. A kindly servant tore a strip of cloth off his turban and wrapped it round his wounded feet. In this state he hobbled the remaining distance.

THE HORRORS OF PRISON LIFE

The prison at Oung-pen-la presented a similar scene of horror to that at Ava. The keepers of the prison were all branded criminals, some bearing the name of their crime branded into the flesh of their foreheads or their breasts. At night a long bamboo pole was passed through the ankle-fetters of the prisoners to preclude the possibility of escape, and raised to a considerable height. So suspended, they had to pass the night tortured by the mosquitoes, which bit their bare feet and could not be driven away. In the morning the pole was lowered nearer the floor, and the blood flowed slowly back into their benumbed limbs.

A revolting feature of grotesqueness was added to all this horror by the sight, in a bamboo cage close to the prison, of a lion which was being slowly starved to death. It had originally been presented by some foreigner to the Emperor, and was a favorite with him. But when the war with the English began it was whispered about the court that the English bore a lion on their standard, and that this unfortunate beast was in some mysterious way



DR. JUDSON IN PRISON

their ally. Accordingly it was sent to the death-prison and slowly starved, while its roarings filled the jail, in the hope that its sufferings would somehow tend to the weakening of the British force. On its death Dr. Judson obtained the use of its cage during the daytime, which was a very considerable relief to him.

At last, after twenty-one months of misery, from June, 1824, to March, 1826, Dr. Judson was released on the nearer approach of the British forces, and sent down the river to act as an interpreter in drawing up the treaty with the English. The rapture of release was indescribable.

As Dr. Judson said afterwards, when one evening people were comparing different degrees of delightful experiences: "What do you think of floating down the Irrawaddy on a cool moonlight evening, with your wife by your side and your baby in your arms, free, all free? I can never regret my twenty-one months of misery, when I recall that one delicious thrill."

Dr. Judson continued his work as missionary for thirty-eight years, translating the Bible into Burmese. He died at sea April 12, 1850, while on a voyage for his health. He was one of the world's great men.

MADAGASCAR MARTYRS

A MIRACULOUS ESCAPE

WHEN Colonel Tod, one of the first British officials to explore India, was exploring a section called the Region of Death, the party came to a place where they must descend a very steep pass nearly two miles in length. The path grew more and more narrow, and so taken up were the riders managing their horses that they were scarcely aware of a path which forked to the left, until all at once the watchers above were horrified to see the horse of young Lieutenant Carey shy, swerve, and disappear down this side path into a swirling stream. They ran to the spot, but could hear no sound nor see any trace of the lad. At last they were forced to give up the search and go on, but the fate of "little Carey" weighed on Colonel Tod like a nightmare. After a restless night he was awakened by the shout of the men, as Carey walked in, whole and jovial as ever. His horse had been killed, but he had managed to gain the farther bank and find a place to get across.

ATTACKED BY A LION

As Gordon Cumming, the African lion-hunter, was crossing the Kalahari Desert, he dozed in his wagon, but was roused as the negro who was leading the team took a flying leap into the wagon and uttered wild screams. A magnificent lion was standing in the path and sprang with a fearful yell at one of the leaders. Cumming's first shot wounded him, but he leaped for the wagon, when, with the beast in the air before him, the hunter fired a bullet which passed from eye to brain.

DAVID LIVINGSTONE

"I SHALL open up a path to the interior, or perish," wrote David Livingstone, one of the greatest explorers of the nineteenth century. Determination was the strongest mark of his character even as a young boy. At the age of ten he went to work in a cotton factory in Scotland. With his first wages he bought a Latin grammar, and, though he worked fourteen hours a day in the factory, he carried out his determination to educate himself. At nineteen he made up his mind to be a medical missionary. As he himself wrote, "In the glow of love which Christianity inspires, I resolved to devote my life to the alleviation of human misery." He was accepted for service by the London Missionary Society, and in 1840 sailed for South Africa.

When he landed at Cape Town in 1841, he found the missionaries massed together at the southern extremity of the continent, while inland lay vast regions utterly unexplored. After residing for a time at Kuruman, where he secluded himself for six months among the natives in order to learn the language perfectly, he removed to Mabotsa. Here his famous adventure with a lion took place. He was shooting at the animal when it sprang at him and caught him by the shoulder, and they both came to the ground together. Growling horribly, the lion shook him as a terrier dog shakes a rat. Fortunately a native firing at him distracted his attention. He left Livingstone to attack the native, and bit him in the thigh, but soon afterwards fell dead from the musket-balls which he had already received. Eleven of his teeth had penetrated the upper part of Livingstone's arm, and had crunched the bone into splinters.

Livingstone prepared for his first long journey, in the hope of discovering Lake

Ngami, of which rumors had reached him. He was accompanied by two English travelers, Oswell and Murray, and left Kolobeng on June 1, 1849. A neighboring chief, Sekomi, sent a message of strong dissuasion. "Where are you going? You will be killed by the sun and thirst, and then all the white men will blame me for not saving you." Other natives were not behind in expressing their surprise at the three travelers' daring to enter the waterless region of the great Kalahari Desert. "Have these hunters, who come so far and work so hard, no meat at home?" They had immense difficulty in crossing the desert, owing to the scarcity of water, and were often tantalized by mirages, which appeared so real that not only the Europeans but the natives were deceived by them. On the 1st of August, they reached the shores of Lake Ngami, which had never before been seen by European eyes.

Livingstone would gladly have gone farther north, but was forced to return to Kolobeng by the want of supplies. In April, 1850, he again started for the lake with Mrs. Livingstone and her three children. They had a terrible experience in crossing the desert, as the supply of water in the wagons had been wasted by the carelessness of their servants. For four days they could find none, and the children nearly died of thirst. "Not one syllable of upbraiding was uttered by their mother," says Livingstone, "though the tearful eye told the agony within. In the afternoon of the fifth day, to our inexpressible relief, some of the men returned with a supply of that fluid, of which we had never before felt the true value." The difficulties of the desert march were increased by the presence of the tsetse fly, which destroyed forty-three fine oxen.

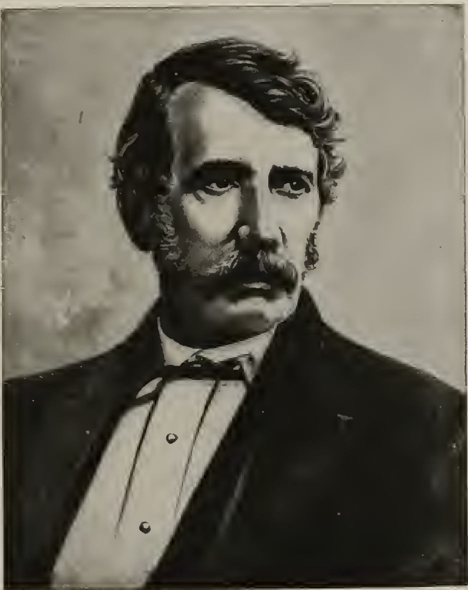
Arrived at the north of Lake Ngami, Livingstone made the acquaintance of Sebituane, chief of the Makololo, a remarkable man, who, by his courage and audacity, held all the surrounding tribes in awe. He was pleased with the proof of confidence the missionary had shown in bringing his children. Unfortunately he was soon taken ill, and Livingstone was afraid to treat him medically, lest in the event of his death he should be blamed by his people. To Livingstone's distress, this occurred soon afterwards, and Sebituane was succeeded by his son, Sekeletu, who also became a warm friend of the missionary.

During this expedition Livingstone discovered the Zambesi, which had previously been supposed to rise much farther to the east. Not being able to find a healthful place in which to settle Mrs. Livingstone and his family, Livingstone resolved to send them home before he proceeded farther inland. Accordingly he accompanied them to Cape Town in 1852, and set out again with a very sorry equipment of wagons and oxen, owing to scarcity of funds, for the interior. The Makololo were startled at his coming again among them, and said: "He has dropped among us from the clouds. We Makololo thought no one could cross the Chobe without our knowledge, but here he drops among us like a bird." They took the wagons to pieces and carried them across the river on a number of canoes lashed together. The whole population of Linyanti, the chief town of the district, numbering between six and seven thousand, turned out to see the wagons in motion, having never seen such a thing before. Sekeletu sent the court herald to greet them, who, leaping and shouting at the top of his voice, roared out: "Don't I see the white man? Don't I see the comrade of Sebituane? Don't I see the father of Sekeletu? We want sleep. Give your son sleep, my lord!" (sleep meaning security from foes). Soon after his arrival at Linyanti, Sekeletu asked him to mention anything he wanted, offering to give him freely any object required. When Livingstone said his object was to teach him and his people Christianity, the chief replied that he did not wish to learn the Book, "for he was afraid it might change his heart, and make him content with only one wife like Sechele."

Failing to find a healthy spot for a settlement near Linyanti, Livingstone determined to open up a way to Loanda on the west coast, or, as he wrote to his father-in-law, Dr. Moffat, "perish in the attempt." A "picho" or native assembly was held to deliberate on the arrangement for his march. One diviner tried to frighten his followers from accompanying him, and said: "Where is he taking you to? The white man is throwing you away. Your garments already smell of blood." Sekeletu, however, laughed at him, and twenty-seven men

were deputed to accompany Livingstone. He was convinced that no permanent elevation of a people can be effected without commerce, and that the opening of a route to the coast was therefore of the greatest importance.

Only a man of indomitable courage would have undertaken such a journey, through unknown regions and tribes for eight hundred miles, being already weakened by constant attacks of fever. If he looked up quickly, he was seized with a strange giddiness; everything appeared to rush to the left, and, if he did not catch hold of some support, he fell heavily to the ground. "But," he says in his journal, "I had always believed that if we serve God at all, it ought to be done in a manly way, and I was determined to succeed, or perish in the attempt to open up this part of Africa."



DAVID LIVINGSTONE

To avoid heavy loads, he only took a few biscuits, a few pounds of tea and sugar, and about twenty of coffee. One small tin canister about fifteen inches square was filled with spare shirts, trousers, and shoes, to be used when he reached civilization again; another of the same size was stored with medicines; a third with books, and a fourth box contained a magic-lantern, which was found of much service.

Proceeding up the Zambesi in canoes, he arrived among the Balona tribe ruled over by a female chief, Nyamoana. She sent her daughter Manenko, a strapping woman of twenty, to escort him to her brother, the chief Shinté. Manenko was something of a virago. When Livingstone was making ready his packages, she said the men whom she had ordered for the service would not arrive till the next day. Annoyed at the delay, Livingstone ordered the packages to be put into the canoes at once; but Manenko was not to be circumvented in this way. She came forward with her people, seized the luggage, and declared she would carry it in spite of him. His followers laid down their loads, and Livingstone, left powerless, was moving off in high dudgeon to the canoes, when she placed her hand on his shoulder and said, "Now, my little man, just do as the rest have done." Amused at her masterfulness, he forgot his feelings of annoyance, and went off with his gun to spend the time in trying for some game.

When they started, this stalwart princess marched in front as leader, and at a pace with which few of the men could keep up. Livingstone, mounted on ox-back, followed close behind, and asked her why she did not clothe herself, as it was raining. She answered that a chief ought not to appear effeminate, but must always wear the appearance of robust youth, and bear hardships without wincing. His men, in admiration of her pedestrian powers, kept remarking, "Manenko is a soldier," and they were all glad when she proposed a halt to prepare their night's lodging on the banks of a stream.

As they went forth, they found themselves in the dense gloom of the Central African forest,

through which they had to pass by a narrow way cut by the ax. Immense climbing plants entwined themselves like boa-constrictors around gigantic trees, and often stood erect by themselves, having choked the trees by which they had been supported. Although drenched with rain and often suffering from fever, Livingstone says he found this dense gloom refreshing after the scorching glare of the Kalahari Desert. Even here, he could never see water thrown away without feeling that they were guilty of wasting it, having so often in the desert experienced the enormous difficulty of finding it.

At Shinté's town, he came upon Portuguese slave-traders for the first time. His followers, who had never seen these men-sellers before, exclaimed, "They are not men; they are beasts who treat their children so."

At the place of audience, they found the chief Shinté on a sort of throne covered with a leopard's skin. He was dressed in a check jacket and a kilt of scarlet baize, edged with green; strings of large beads hung from his neck, and his limbs were covered with iron and copper armlets and bracelets; on his head he wore a helmet of beads neatly woven together, and crowned with a great bunch of goose-feathers by way of crest.

On learning that "Shinté's mouth was bitter for want of ox-flesh," Livingstone presented him with an ox, to his great delight, but the masterful Manenko, hearing of it, came up with the air of an injured person, and explained that, "The white man belonged to her; she had brought him here, and therefore the ox was hers, not Shinté's." Upon this she ordered her men to bring it, had it slaughtered, and presented her uncle with a leg only. Shinté did not seem at all annoyed at her interference.

Here Livingstone exhibited his magic-lantern. The first picture shown was the sacrifice of Isaac, and the women listened silently to his explanation of it, but as the slide was being withdrawn, the uplifted knife seemed moving towards them, and they thought it was to be sheathed in their bodies instead of Isaac's. They all shouted, "Mother! Mother!" and rushed off, tumbling pell-mell over each other, and nothing would induce them to return. Shinté, however, sat bravely through the whole, and afterwards examined the instrument with interest. It was the only mode of instruction Livingstone was ever pressed to repeat. The people came long distances to see the pictures and hear the explanations.

When Livingstone took his departure, Shinté, as a sign of friendship, hung a conical shell round his neck, "an article in regions far from the sea of as great value as the Lord Mayor's badge is in London." He also gave him a native guide named Intemese, who proved a great plague to the traveler, and lied on all occasions to save himself trouble.

The serious difficulties of the march now began. They entered a region where no animal food was to be procured. One of the guides caught a mole and two mice for his supper, and the care with which he wrapped them up in a leaf and slung them on a spear showed that there was little hope of finding larger game. The chiefs through whose country they were now passing proved covetous, and demanded toll. Livingstone pacified one by sending him the worst shirt in his stock. Another chief named Njambi, of the Chiboque tribe, was not so easily satisfied. He sent an impudent message demanding either a man, an ox, a gun, powder, cloth, or a shell; and, in the event of refusal, intimated his intention of preventing their further progress. When this demand was refused, he collected his people and surrounded their encampment, evidently intending to plunder them of everything. Livingstone's men seized their javelins and stood on the defensive, while he sat on his camp-stool with his double-barreled gun across his knees. Njambi came for a parley, and sat on the ground in front of him. After a lengthy discussion, Livingstone gave him one of his shirts. On Njambi's followers showing dissatisfaction at this, he added a bunch of beads, and again a large handkerchief. The more he yielded, however, the more unreasonable they became. At every fresh demand they shouted and rushed towards him, brandishing their weapons.

In the meantime, Livingstone's Makololo followers, outnumbering the Chiboque party, had quietly surrounded them and made them feel there was no way of escaping their spears.

Livingstone then said that as everything had failed to satisfy them, it was evident that they wanted to fight, and that if so, they must begin first and bear the guilt. Calming down at this, and seeing his party outnumbered, the chief said, "If you give us an ox we will give you whatever you wish, and then we shall be friends."

Accordingly the ox was given to them, and, in return, two or three pounds of its flesh were sent back with a very small basket of meal. Livingstone adds, "It was impossible to avoid laughing at the coolness of these generous creatures."

Added to these difficulties was the nature of the country and the season of the year. It was during the rains, and they had to flounder through several rivers, holding on by the tails of the oxen. Crossing the river Loke, Livingstone became separated from his ox, and was obliged to strike out for the opposite bank alone. His followers were greatly alarmed on seeing this, and about twenty of them made a simultaneous rush into the water for his rescue. Just as he reached the opposite bank one seized his arm and another clasped him round the body. They expressed great pleasure on finding that he could swim.

Owing to the constant exactions and attacks of the tribes through whose territory they were now passing, Livingstone's men began to get disheartened. Some of them proposed to return home, but he could not endure the prospect of returning when just on the threshold of the Portuguese settlements. After using all his powers of persuasion, he declared to them that if they returned he should go on alone, and retired to his little tent. Thither he was soon followed by the headman, who said: "We will never leave you. Do not be disheartened. Wherever you lead we will follow. Our remarks were made only on account of the injustice of these people." Others followed, and with the most artless simplicity of manner told him to be comforted. "They were all my children; they knew no one but Sekeletu and me, and they would die for me; they had just spoken in the bitterness of their spirit, and when feeling that they could do nothing." At last they arrived at the edge of the high land on which they had been traveling. At the depth of a thousand feet below lay the magnificent valley of the Quango. Livingstone had been so weakened by twenty-seven attacks of fever that in going down the descent he had to be supported by his companions. "Emerging from the gloomy forests of Loanda," he says, "this magnificent prospect made us all feel as if a weight had been lifted off our eyelids."

Not long afterwards they beheld the sea from the elevated plains of Loanda. The Makololo were much impressed, and in describing their feelings afterwards they remarked, "We were marching along with our father believing that what the ancients had always told us was true, that the world has no end; but all at once the world said to us, 'I am finished; there is no more of me.'"

The large stone houses and churches of Loanda struck them with little less awe. One of them before this had said of Livingstone's house at Kolobeng, "It is not a hut; it is a mountain with several caves in it." Visiting one of the ships in harbor with Livingstone, they said, "It is not a canoe at all, it is a town! And what sort of a town that you climb into with a rope?"

Thus successfully ended the first of those long journeys by which David Livingstone, as he said, was resolved "to open up Africa or perish."

He has deservedly been called "the greatest of African travelers." He discovered the Congo River and Lake Nyassa (a lake 350 miles long), and did more than any other man to carry daylight into the heart of Africa. He died in Africa, but through the devotion of his native followers his body was carried hundreds of miles to the coast, and now lies in Westminster Abbey.

ELEPHANT HUNTING IN AFRICA WITH LIVINGSTONE

THE famous explorer and missionary, Dr. Livingstone, did not hunt for sport, but frequently had to kill an elephant, a buffalo, or a rhinoceros either in self-defense or for food. He had some exciting adventures. When for the second time he was making his way to the Zambesi River, as his party was crossing a specially beautiful valley, in which big game was plentiful, the first animal to meet his eye was a buffalo, and as the larder was by no means well stored just then, he put three bullets into him. The buffalo, however, was by no means killed, and prepared to charge his aggressors. Everybody made for the shelter of some rocks near. But their hasty stampede in that direction was brought to a sudden stop by the sight of three elephants, which blocked the way. Here was an awkward pass — an infuriated buffalo behind, three huge African elephants in front. Then an unexpected turn of events came; the elephants wheeled round and made off. At the same time the buffalo was observed to be moving away with all speed.

Livingstone, disappointed at his failure to procure a fresh supply of meat, took a long shot at one of the elephants. To the joy of his men, the bullet brought the animal down, its leg broken. It was speedily dispatched by the next shot, this time at close quarters, which pierced the brain. The killing of the elephant brought from the neighborhood round quite a gathering of natives, all eager to share the unwonted plenty.

A NARROW ESCAPE

In Livingstone's party was a friend, Mr. Oswell, who had had more narrow escapes than any man living, according to Livingstone, but was so modest that he would never tell his exploits. The missionary tells one of these remarkable adventures for him. It was on the banks of the Zouga River. The neighborhood of the banks was covered with a thick fringe of stout thorn bushes. These thorns are serious things to encounter, and in truth horses cannot be induced to face them at all. The spines are placed in pairs on opposite sides of the branches, and as these turn round on being pressed against, one pair brings the other exactly into the position in which it must pierce the intruder. They cut like knives.

Into a dense thicket of this kind Mr. Oswell pursued an elephant, that animal being accustomed to betake himself to such bushes for safety when attacked. The Englishman was on horseback, and followed the elephant along a narrow pathway that had been made in the thicket.

He lifted up opposing branches here and there where necessary, in his anxiety to keep close on the trail. Suddenly, at a spot where he had got himself jammed in pretty tightly among the thorns, Mr. Oswell descried the elephant, which he had almost lost sight of, bearing straight down upon him. He turned and sought to flee, trying hard to force his horse through the bushes, there being no time to lift up branches. This he could not do, and, realizing the extremity of the danger in which he stood, he tried to dismount, so as to make off on foot. Unfortunately his foot was caught by a branch, and this caused his spur to drag along the horse's flank, scoring it badly. The animal gave a plunge and threw his rider violently to the ground, face toward the elephant. The unwieldy brute, full of rage, was upon him in a moment, and he beheld one of the huge forefeet descending upon his prostrate body, or rather upon his legs. Quick as thought, the man threw his legs apart, and so escaped the first step. Then he drew in his breath to stand the awful pressure of the other descending foot. Luckily, and most strangely too, that missed him. There as he lay, he saw the whole body of the huge beast pass over him, yet he was not touched. Presently he was able to spring to his feet again, when he found that his horse had likewise received no injury. It was a remarkable escape, and Dr. Livingstone says he never heard of more than one other authentic instance in which an elephant went over a man without injuring him. And he adds that for anyone who knows the nature of the bush in which this occurred, the very thought of an encounter in it with such a foe is appalling.

TATTOOED CHIEFS OF AN AFRICAN TRIBE

SIR RICHARD BURTON IN AFRICA

THE man who can speak fluently nearly thirty different languages, play four games of chess at a time blindfold, hold high rank among English men of letters, be a distinguished soldier and diplomat, and one of the world's greatest and bravest explorers, must needs be a genius; and such was the late Captain Sir Richard Burton.

While still a young soldier serving in India he had made for himself a considerable reputation as a traveler, for his furloughs were spent in journeying, often quite alone and in disguise, through regions then but little known.

It was during one of these periods of leave (1857-1858) that he undertook the command of an exploring expedition that was to proceed across East Africa from Zanzibar to Lake Tanganyika — a country of swamps, deserts, forests, and barren mountains and valleys.

He landed at Kaol with an escort of two small companies of Baloch, or soldiers of the Sultan of Zanzibar — one to act as temporary guard till the expedition was well into the interior, the other to accompany it the whole way.

Burton had every intention of pushing forward at once, but the Baloch had other views. It was only by the exercise of much patience and tact that he lured them from their stopping-place outside Kaol; and, when short but dreary marches over thorn-grown sand brought them to the grassy swamps of Bomani, the escort immediately began to make preparations for a lengthy stay, and the Captain "tasted all the bitterness that can fall to the lot of those who explore regions unvisited by men of their own color. The air of Bomani is stagnant, the sun fiery, and clouds of mosquitoes make the nights miserable. Despite these disadvantages, it is a favorite halting-place for up caravans, who defer to the last the evil days of long travel and short rations . . . and I could not persuade the Baloch to move. In Asia two departures usually suffice; in Africa there must

be three — the little start, the great start, and the start in chief. Some clamored for tobacco, others for guitar-strings, and all — born donkey-drivers — complained loudly of having to load and lead an ass."

Up to a certain limit Burton could lay claim to the patience of Job, but beyond it he was a dangerous man to trifle with. That limit was reached when, standing in his tent, he overheard some of the guard (using a local dialect of their own, of which he was supposed to be ignorant) roundly cursing himself and his European companion, and trying to stir their comrades to mutiny with the remark, "They are infidels, and shall not march under our flag."

The words were scarcely out of the speaker's mouth when Burton stood facing the group, revolver in hand.

"Listen to me, my children," he said softly, but loudly enough to be heard by everyone. "I 'm going to blow the head off the next man who says I shall not march under the Baloch flag."

He had spoken to them in precisely the same patois which they had employed, and the effect was extraordinary. Some of the mutineers dropped their arms and threw themselves on the ground, fearful of witchcraft; others set up a dismal howl, and rushed to hide in their tents; while a third lot humbly expressed their sorrow, and denied part or lot with the would-be mutineers.

For the remainder of the day the order observed among the guards was perfect; they scarcely ventured to speak above a whisper. But in the morning strange and wondrous tales were floating about the camp of savages lying in wait to kill and cook the guard; of traps set to catch strangers; of a body of Wazarano negroes, several thousand strong, intrenched on the route, who would rob them to their very shirts; and the Jemadars, or Baloch officers, reported that they were powerless to persuade their men to strike tents.

"Such reports did real damage. The principal danger was the tremendous alacrity with which the escort prepared, upon each trivial occasion, for battle, murder, and sudden death. A squabble among the villagers kept the Baloch squatting on their hams with lighted matches from dusk till dawn. A hyena, entering the camp by night, caused a confusion which only the deadliest onslaught could have justified. A slave, hired on the road, hearing of these horrors fled in dismay. This, the first of desertions, was by no means the last."

At last Burton would stand such miserable cowardice no longer. On the third morning he issued an order that the guard must be ready to march within an hour. Some of the Baloch sat down and wept, others sulkily saddled asses or buckled on knapsacks, jeering the while at the few whom military instinct and training bade obey unhesitatingly. Five minutes before the hour Burton called to him his European friend, his two half-caste Portuguese-Hindu servants, and the more trustworthy of the guides and Jemadars; and, when the bugle sounded to fall in, a small force armed with donkey-whips emerged from the Captain's tent. To those who were in their places Burton gave a brief command to fire on any runaway; then he led his tiny army towards the dawdlers.

"We are ready to start, gentlemen; you, apparently, are not," he said, and immediately caught the nearest man by the back of the neck, and swung him spinning across the ground to the line. This was the signal for general onslaught; whips flew high and fell heavily, and in a few moments the recalcitrants were glad to fall in — all except one, who lifted his gun threateningly, and straightway lay sprawling from a blow of the leader's fist.

"Now I think we 're all ready," said Burton with grim politeness as the final loiterer was hustled into position by his Jemadar. And this was start No. 2. Start No. 3 followed upon a halt rendered necessary by the discovery that, in the hurried departure from Bomani, several tools and instruments had been left behind, and while these were being sought a couple of donkeys strayed and had to be chased.

The "start in chief" was at length made, but no sooner was the expedition embarked on the wooded desert on the way to Wady-el-Maut than a quarrel arose among the escort; and when this was subdued thirteen of the Baloch fled coastwards, and had to be pursued by a Jemadar.

During the next few days progress was slow, for the desert-forest was far more impassable than its sandy companion. The only water to be seen was the malarial filth in the hollows, the very smell of which bred fever. Hyenas lurked about the camp after nightfall on the chance of prey; even in broad daylight three asses were killed by the fierce African wolves; and farther afield, and sometimes alarmingly near, sounded the sullen roar of the forest lion.

Escape from such a neighborhood was relief, even though it was by way of the cheerless slope leading down to Wady-el-Maut and Dar-el-Jua — "the valley of death" and "the home of hunger." Before making the descent Burton halted for examination of stores, and found that packages intrusted to the Baloch had been pilfered from. He remonstrated, with the result that a Jemadar, who had been censured for negligence, turned about and announced that he was going home; but he was stopped in mid-career by a cry from his friends which warned him that he was covered by the Captain's gun-muzzle.

So great was the heat here that Burton would have halted till the next day but that the whole party had not a quart of water among them, and there was little chance of finding any till the valley was reached. The incline was longer than had appeared, and by evening they seemed no nearer the bottom than at starting. The guard and the asses were dead-beat, and a halt became imperative.

It was a restless night for Burton. His only friend had malarial fever; his own tongue was black with thirst, and the howls of fear or pain from the Baloch were enough to prevent any man sleeping. Before it was light he ordered the reveille to be sounded, for the want of drink now threatened to drive everyone mad. The thirsty, jaded donkeys were urged down the hill till, probably smelling water, they cantered of themselves; and, by the time the sun was up, the beasts were straining madly forward through a dense mass of spear-grass, tiger-grass, and tangled thorns to where a stream, clear and silvery from a distance, was seen to wind.

Water it certainly was, and everyone drank greedily of it; but it was crawling with things only of interest to biologists, and he who drank of it did well to first guard his nostrils against the odor thereof.

While the party was still indulging in rest and refreshment sudden yells of fear from the escort attracted Burton's attention to the arrival of a body of savages armed with spears. The Jemadars endeavored to keep their men from

BABOON ATTACKED BY LEOPARD — ATTACKED BY BOARS — JAGUAR FOUGHT BY PECCARIES

fleeing, while Burton and his chief guide went up and addressed the leader, offering him presents of cloth and beads. Manifestly there was nothing to fear here, for the barbarians seemed prepared rather to suffer death than to inflict it, and were overjoyed at the white man's gifts.

The next stoppage was at a river of which the valley-stream was doubtless a feeder. Here Burton's elephant-gun, an old friend, fell into the water, and the only servant who dared dive in search of it — Gaetano, one of the half-castes — would have been seized by a crocodile but for a timely bullet from Burton's revolver, which either killed or blinded the monster.

Beyond the river a day's deer-shooting supplied the company with abundance of flesh food, not altogether a piece of good fortune, for the Captain was too ill from sudden fever to superintend the distribution of the meat, and the two Goanese half-castes and half the Baloch nearly died through overeating.

Again the marching rate dropped to but a few miles a day, with often a day's rest between; for Burton's weakness and occasional delirium forbade his regulating the journey. After a week, however, his extraordinary vitality triumphed, and he was again able to sit his ass and take command. Concerning the African ass, he says:

"He is stubborn, vicious, and guilty of the four mortal sins of the equine race — he shies, stumbles, rears, and runs away. . . . The animals are addicted to fidgeting, plunging, and pirouetting when mounted; they hog and buck till they burst their frail girths; they seem to prefer holes and hollows; they rush about pig-like, when high winds blow, and they bolt under tree-shade when the sun shines hot. The roundness of their flanks, the shortness of their backs, and their want of shoulder combine to make the meager Arab saddle unsafe for anything but a baboon or a boy, while the straightness of their goat-like pasterns render the pace a wearisome, tripping hobble."

As soon as he was well enough he took another inventory. Several more asses were missing, and provisions were unaccountably diminished, as were also many of the rolls of cloth and bags of trinkets brought as presents to native chiefs.

The official grant of money had been so small that only the most rigid economy from the very first would allow of his stores holding out, and these repeated losses were beggaring him before anything like half of the journey was accomplished.

Probably every modern explorer, from Columbus to Stanley, has been obliged to face some dark hour in which the temptation to "give up and go back" has assailed and well-nigh overcome him, and it is nothing to Sir Richard Burton's discredit that his case was not to be an exception. The whole undertaking now seemed hopeless and quixotic. If ever he reached Tanganyika it would, at this rate, be without ammunition, provisions, or presents; and the Baloch, even when well fed, could hardly be expected to face the cannibal hordes said to inhabit the shores of the lake.

But, like the brave man he was, he put temptation from him, and, taking comfort from the guides' assertion that they were nearing Dut'humi, a fertile and well-watered area, he resolutely shut his eyes to his losses and to the growing discontent of the Baloch, and steered for the land of promise that lay ahead.

Dut'humi was reached and passed, its fertility soon giving place to bare hillocks, beyond which were fever-swamps, "where the earth emits the odor of sulphuretted hydrogen, and in some parts the traveler might fancy a corpse to be hidden behind every bush."

At the native village of Zungomero, where the temporary escort was dismissed, Burton engaged a considerable number of native bearers, after which he was very glad to leave, for the remaining Baloch distinguished themselves by wholesale robbery of native huts and henroosts, and at times a general fight seemed inevitable.

Once away, they were soon in the hill district — the East African Ghâts — where the two Europeans quickly got rid of the ill effects of fever. Howbeit it was only to run the risk of contracting smallpox, which disease was introduced by some of the new porters, and which spread so rapidly that "the way became strewn with corpses." Farther on, another donkey dropped dead, thus reducing the number of those worthy animals to twenty-three.

A fresh epidemic of dishonesty, aggravated by

insolence, broke out among the Baloch, and Burton felt that the time had come when either he or they must be master. At Zonwhe he suddenly ordered the men to turn out for inspection of kit. They paraded, and their officers appeared to make a careful scrutiny, but none of the missing property was forthcoming. This was reported by the chief Jemadar to Burton, who from his hammock watched the proceedings.

"If you can't find the guilty man I must put you all down as thieves," he said, knowing full well that this officer was the biggest rogue of them all.

The Jemadar laid his hand on his sword-hilt menacingly, as he replied:

"In Zanzibar we are accounted men of honor, and should be trusted with untold gold."

"In Zanzibar they probably don't know you as well as I do," retorted the Captain.

The man's face grew hideous with rage.

"It had been well had we never seen you!" he shouted. "You have starved and overworked us ever since you took us from our homes."

"You are a lying scoundrel!" said the English officer, calmly.

The Jemadar's eyes flashed, and he drew his sword.

"Either take back your words or you shall die!" he screamed.

Burton laughed softly, as did his friend. The valiant Baloch leader was innocently threatening the man whom both French and English armies regarded as one of the most expert swordsmen of Europe. Still lounging back, and looking lazily up at the Jemadar with the peculiarly cold stare for which he was celebrated, the Englishman said:

"You — are — a — lying — scoundrel!" then added in more business-like tones, "And now sheathe your sword, or you 'll first be kicked, and then put under arrest."

"Truly this man is possessed by the devil," muttered the awestruck African, and he hastily turned away to vent his rage on the chief guide, deciding that baiting a British soldier was poor sport. The two men were soon at high words, and the other Baloch joined their leader, all shouting in chorus:

"We will have at least one sheep a day to eat, or else go home."

As the guide, almost his only loyal follower, was in danger of being mobbed or murdered,

VILLAGE OF AFRICAN NEGROES

Burton pushed his way unceremoniously to his side.

"*What?*" he said, addressing the Baloch, who fell back respectfully as his hand touched the revolver in his belt. "A whole sheep a day among a gang of idle rascals who in Zanzibar are half starved, and never see mutton once in a month unless they steal it! You'll have what I choose to give you. To your tents, you — you — *heroes!*"

In the evening the chief guide reported that the escort was deserting.

"I shan't stop them," said the Captain. "They 'll come back the first time they hear a hyena howl."

He was tired of their greed, cowardice, and ingratitude. One of the noisiest of the mutineers had not long before been seized with fever. Burton had sat up with him a whole night, tended him with all care, and even given up his ass to the invalid, though himself scarce well enough to walk.

The following evening anxious shouts from behind announced the truth of his prophecy. The Baloch were coming back, hungry and contrite, and imploring that their defection should not be reported at Zanzibar.

After this the robberies were reduced to a minimum, and there were no more open complaints about rations. But, the Baloch being quieted, it was high time for the native porters to begin, and during the descent of the Rubeho, or "windy pass," a dispute arose between these unclad gentlemen, which resulted in their dropping their burdens and clawing each other till they felt better, or till the interpreter hinted that the terrible white stranger who could quell a mutiny could also knock their woolly heads together.

On entering the Ugogo country the caravan was a second time "held up" by savages, who demanded presents — and got them; while fifteen of the porters thought this a fitting occasion to desert. Thus delayed till nearly evening, Burton had considerable difficulty in finding a suitable camping-ground; for, when at last water was discovered, the tents were pitched on a sand-hill, which soon announced itself to be an immense ant-heap, the dwellers in which had a special bite of their own. In great haste everyone withdrew to the neighboring valley, and arrangements were almost complete, when a swarm of wild bees, more formidable than English wasps, put in an appearance, driving away even the English soldier, who had faced a dozen Afghans single-handed.

Yet Burton began to regard his troubles lightly, for only the "Fiery Field" — a broad jungle with mud-pits to do duty for wells and pools — and the "Land of the Moon" lay between him and his goal. Nevertheless, the last part of the march was to be marked by further desertions from his troop, and by a temporary attack of paralysis for himself, following on sunstroke.

Having met, and bribed, and entered into treaty with Kannena, the most powerful of the lake-tribe chiefs, the explorer left most of the men at the camp some distance from the shore, and then spent some weeks in navigating Tanganyika, narrowly escaping death from malaria and crocodiles. On his return he found the camp surrounded by a hungry swarm of the famous Murriumba man-eaters. But the appearance of these men was less awe-inspiring than their name; they were but timid and spiritless creatures, and a couple of volleys of birdshot caused them to leave hurriedly.

On the night before the return journey was to be commenced, Burton was waked by loud cries, followed by the report of a pistol. He hastened out to find Valentine, the second half-caste, a close prisoner in the center of a torch-lit group of natives of Kannena's tribe, one of whom bore the outward signs of being royal executioner, while the Baloch kept at a safe distance. The Goanese lads had been servants of Burton's for some years, were indifferently faithful, and had come all the way from India with him, so that he felt more responsible for Valentine's safety than if he had been a Baloch.

When after much struggling he reached the center of the crowd, it was to find the negroes clamoring for the half-caste's blood, while the interpreter argued and pleaded with Kannena. The Captain's appearance made the executioner draw back, and gave some heart to his servants, who tried to explain matters.

One of the tribesmen, mad with drink, had started, club in hand, to run amuck through the

camp; the guard had acted after its kind, while Valentine, with more pluck than discretion, had fired one of his master's revolvers, of which he had temporary charge. The bullet had missed the delinquent, and drilled a hole through the nearest of his companions.

"He must die!" shouted Kannena — a sentence which gained in popularity as it was passed from mouth to mouth.

"Listen, O Kannena," said Burton, holding up a revolver; "the first man who lays a hand on my servant will die, perhaps in much pain, and the second and third likewise, even to the sixth."

Kannena smiled triumphantly, and presented the weapon that had been taken from Valentine; but the Englishman laughed in his face.

"No good; the lad had but one cartridge, and it is used. I have six."

"I can bring many hundreds of men against you who will kill you," argued the black chief.

"If I do not return home alive, O chief," returned the explorer, "bear in mind that I come from a country that can bring many *thousands* of men against *you* — white men, who would burn your homes, and blow you all up to the clouds."

The words created a sensation. Many *thousands* of white men! Was ever the like heard of? Fearless men such as this one? And all armed with things that had only to be held out to go off with a thunderclap and to kill?

The wiseacres of the tribe pressed round their chief urging forgiveness as clamorously as they had demanded the death penalty. Anything was better than bringing a swarm of white men about their ears. And, after all, the man who had been shot was only a slave.

Kannena jumped at the final argument as a convenient loophole. Only a slave, was he? Of course that put a new aspect on the case.

After further deliberation the magnanimous chief told the prisoner he would be released on payment of a fine. A bale of cloth and some more beads met this, and the natives withdrew, absent-mindedly taking with them three goats that did not belong to them. Burton subsequently examined and treated the slave, and left him in a fair way to recovery.

The monotony of the homeward journey was broken by a squabble between the bearers and some natives whose sheep they stole, and, later, by civil war among the Baloch, who to the last seemed determined on retaining their proud position of annoyance-in-chief to the commander of the expedition.

As the coast once more came in sight, the escort became unnaturally docile and dovelike, in the hope that Burton would render a favorable account of them to the Sultan. His report was ambiguous; for he stated that, throughout, they had acted with the kind of valor and obedience to be expected of true Baloch.

ONE AGAINST TWO HUNDRED

A MAN whose name will be remembered as long as history endures for the many adventures through which he passed in his struggles for the freedom and independence of his country, is Robert Bruce of Scotland. Of the many stirring incidents of his life we select that of his single-handed defense of the ford of the Galloway against two hundred armed men. We will follow the account of this heroic deed which is given by Sir Walter Scott in his "Tales of a Grandfather." The King had received word of the intention of a large party to come upon him suddenly and by night. Accordingly he quartered his little troop of sixty men on the side of a deep and swift running river, that had very steep and rocky banks. There was but one ford by which this river could be crossed in that neighborhood, and that ford was deep and narrow, so that two men could scarcely get through abreast. Bruce caused his men to lie down to take some sleep at a place about half a mile distant from the river, while he himself, with two attendants, went down to watch the ford, through which the enemy must pass. He stood for some time looking at the place and thinking how easily the enemy could be kept from passing there if it was bravely defended, when he heard at a distance the baying of a hound, which was always coming nearer and nearer. This was the bloodhound which was tracing the King's steps to the ford where he had crossed, and with it were two hundred armed men determined

CARLAVEROCK CASTLE, STRONGHOLD OF THE FEUDAL DAYS

to take his life. Bruce at first thought of going back to awaken his men, but then he reflected that it might be only some shepherd's dog.

"My men," he said, "are sorely tired; I will not disturb their sleeping for the yelping of a cur." So he stood and listened; and by and by, as the cry of the hound came nearer, he began to hear a trampling of horses and the voices of men and the ring of armor. Then the King thought, "If I go back to give my men the alarm, these men will get through the ford without opposition, and that would be a pity, since it is a place so advantageous." So he looked again at the steep path and the deep river and he thought that they gave him so much advantage that he himself could defend the passage with his own hand until his men should be aroused by the noise of the fighting and come to his assistance.

In the meantime the noise and the trampling of horses increased, and, the moon being bright, Bruce beheld the glancing arms of the troops as they approached the opposite bank of the river. The enemy saw but one solitary figure guarding the ford, and the foremost plunged into the river without so much as minding his presence. But as they reached the narrow landing Bruce stood his ground against them, and, being in armor and well armed, he was able to so drive the foremost men back that soon a considerable number were thrown into confusion and some were drowned. The rest drew back to form some plan, but, again seeing themselves opposed by but a single man, they felt ashamed to retreat, and with increased determination and strongly supporting one another again pressed forward. Again they were met by Bruce's famous long sword, and horses and men were overthrown in the swift current and carried downward to destruction while the giant figure of the heroic King still held the pass, undaunted. Withdrawing once more they attempted to rally in midstream for a final assault, led by their boldest and most daring men, but at that instant the King's troop of sixty men, having heard the conflict, came running to his assistance, and the enemy, who could not take the pass against one man, despaired of success and retreated in great confusion.

By courtesy of Dodd, Mead & Co.

AMUNDSEN'S TENT AT THE SOUTH POLE

THE QUEST OF THE CENTURIES

THE SUCCESSFUL SEARCH FOR THE NORTH AND SOUTH POLES — A THRILLING STORY OF HUMAN DARING AND ENDURANCE

[Whose pulse does not quicken at the thought of what brave men have suffered of peril and hardship in the search for the Unknown? One reason is that they have always been men of ideals, and ideals possess imperishable interest for humanity. It is doubtless well that there are cases where men do not count the cost in any narrow way. The stories of Polar Exploration will never fail to stir enthusiasm. We close our story of Adventure with these accounts of the great discoveries of the North and South Poles, the culmination of centuries of exploration.]

NANSEN AND HIS "FARTHEST NORTH"

IT was in 1893 that Dr. Fridtjof Nansen, the Norwegian, set out for the North Pole on a new route and with an original theory that was laughed at by the arctic experts. For nine years Nansen had been planning, however, and he was confident. He seemed to be an ideal explorer. Born near Christiania, educated at its university, a trained athlete and skillful snowshoeist, when only twenty-one he took a trip in East Greenland for zoölogical specimens. In 1888 he made his memorable journey over the ice plateau, living with the Eskimos, sleeping in their huts, and eating their food. He believed that an arctic explorer must be able to live as the natives do, depending on the country for supplies in case of emergency. Later he had to live just like the Eskimos, and that he was able to do this probably saved his life.

Believing in the theory of a drift from east to west, Nansen boldly declared that a vessel which got frozen in to the north of Siberia must drift across the Polar Sea, and out into the Atlantic. Undeterred by the fate of the *Jeannette* Expedition, he was confident of success. More than this, Nansen himself invented the model of the *Fram*, which was regarded as the strangest vessel ever used in arctic exploration. The hull, round and slippery like an eel, with no corners or edges to give a grip to the ice, was specially designed for ice pressure, its bold inventor's theory being that, when the ice closed

round the ship, she would not be crushed to matchwood, but would be lifted on to the floe, on which her flat bottom would enable her to rest without fear of capsizing. Experts laughed, and declared nothing would save the *Fram* from destruction in the ice crush. But when tested, the *Fram* behaved exactly as Nansen predicted, resting safely on the ice when there was no water to float in.

With all the expert opinion against him, Nansen sailed from Christiania on June 24, 1893, accompanied by twelve of his hardy countrymen. They pursued their way northward, and on July 25 sighted Goose Land on Novaya Zemlya. A thick fog prevailed, and instead of making for land, as intended, the course was set eastward. Two days later the first ice was encountered. Forcing her way through, and already revealing her splendid qualities among the frozen masses, the *Fram* reached Yugor Strait on July 29, and after a few days' stay at Khabarova passed into the dreaded Kara Sea on August 4. Early in September, Cape Chelyuskin, the northernmost point of the Old World, was safely passed, and the way lay clear to the drift ice to the north of the New Siberian Islands. You can follow the journey on the map. By the end of September the *Fram* was frozen in for good, and the long imprisonment began. The ship was a safe and comfortable home, resisting all attacks of the crashing ice.

To Nansen's surprise and disappointment the drift was southward instead of northward. He could not understand it. The conditions continuing, he became depressed. His theory had apparently broken down. He saw that at the rate they were drifting it would take fifty months to reach the Pole, if they could reach it at all; which meant about eight years to get home. Not a cheering prospect for men icebound through the long spring and summer, autumn and winter!

But while the *Fram* was thus slowly drifting with the pack, Nansen made the greatest discovery of the voyage — the existence of a wide, deep sea toward the Pole, thus dispelling the popular theory of a shallow Polar Sea. A northerly drift setting in, the *Fram* was gradually carried to lat. 83° 59′ N., long. 102° 27′ E. Here Nansen left the ship for a Poleward search on foot, handing the ship over to Captain Sverdrup.

With Nansen went only Lieutenant Johansen, and twice they had to return before their final departure on March 14, 1895. It was a hazardous undertaking to cut themselves off from their base and wander out on the bleak and desolate wastes where others had perished. But they were not afraid to take the risks, and with dogs and sledges they set out from the *Fram* on foot, purposing to travel northward for fifty days, for they had only provisions to last for a hundred days, which was all they could carry over the rugged ice floes.

For the first week the progress was satisfactory, the ice good, and traveling easy. But soon the flat track gave way to rough and uneven ice, and over huge obstacles the heavily laden sledges had to be lifted, testing the travelers to the utmost. Sometimes they were almost asleep as they wearily dragged the sledges along, often in the face of blinding snowstorms. By April it was plain that they could not succeed, and Nansen turned back when he was within 261 miles of the Pole, and 190 miles nearer than any man had ever stood before. It was hard to give up and hard to get back to a place of safety. How they lived through the weeks of hardship is a marvel, but they never thought of giving up. The *Fram* reached Norway after three years' absence, and no life was lost on the trip.

OTHER ARCTIC QUESTS

ANDRÉE'S FATAL BALLOON VENTURE

AFTER Nansen's return, there were some novel undertakings. One was the fatal balloon expedition planned and undertaken by a Swedish professor named Andrée, who proposed to explore the North Pole regions by balloon, and easily raised the money by a national subscription, so taking was the idea. Professor Andrée was a scientist, and sure of success. He built a large balloon, which he named the *Eagle*, and made his ascent with two companions on July 11, 1897, from Dane's Island, Spitzbergen. Flying free, the balloon rose to a

Amundsen photo., copyright, Underwood & Underwood

FOUR GREAT EXPLORERS

Top: left, Admiral Robert E. Peary; right, Roald Amundsen. Bottom: left, Fridtjof Nansen; right, Sir Ernest Shackleton.

height of about three thousand feet, and soon disappeared from view — forever, as it proved. It was expected that a point near the Pole would be reached in about sixty hours. Four days later a carrier pigeon alighted on the rigging of the sealer *Alken*, cruising in the vicinity of Spitzbergen. Attached to a tail feather of the bird was a small tube, containing a message in Andrée's handwriting: "July 13, 12.30 P. M., lat. 82° 2': long. 15° 5' east. Good progress eastward. All well on board. This is the third pigeon dispatch. Andrée." This was the only message ever received. Expeditions went in search of the party, but fruitlessly, and what happened will probably remain a mystery.

BOLD BUT FUTILE ATTEMPTS

Prince Luigi, Duke of the Abruzzi, sailed from Christiania in the *Polar Star* in June, 1899, and in spite of tremendous difficulties exceeded Nansen's record by eighteen miles, and planted the Italian flag at the forefront up to that date.

Walter Wellman, an American journalist and traveler, made three desperate attempts to reach the Pole, the last time using an airship, of which he had great hopes. Storms forced him on to a glacier, however, and this, like his previous attempts, had to be abandoned. He had some most thrilling experiences, and discovered a number of islands.

Then came Roald Amundsen, the Norwegian, whose name will appear soon again. He was the first man to navigate the Northwest Passage, which had been sought for centuries. That there was such a passage was discovered by Franklin's expedition, whose members, however, did not live to tell the tale. Amundsen had to prove that the passage was practicable, if it existed. This he did.

Leaving Christiania with the tiny ship, the *Gjöa*, built originally as a fishing boat, on June 16, 1903, he passed along the coasts of Iceland and Greenland, navigated Davis Strait, Baffin Bay, Lancaster Sound, Barrow Strait, Franklin Strait, James Ross Strait, around King William Land, then through a succession of other straits to Cape Parry and Franklin Bay, along the coast of Alaska, reaching Cape Nome on the 31st of August, 1906, and thus sailing through the strip of open sea to the west, and tracing it from end to end by one ship's keel.

It was a grand achievement, and in successfully accomplishing the voyage Amundsen not only demonstrated the existence of a complete navigable passage, but realized at the same time something of the long dreams of youth. For he had been a boy with ambitions. When Nansen returned from his wonderful Greenland expedition in 1889, Amundsen, then a lad, stood with throbbing pulses among the crowds who welcomed back the popular hero, and, as he listened to the tumultuous cheering, some voice seemed to whisper to him, "If you could make the Northwest Passage!" That was the birth of the idea, which remained with him till the great feat was accomplished. This was the man who was to discover the South Pole.

PEARY AT THE POLE

THE North Pole at last! The 6th of April, 1909, was the great day on which Robert Edwin Peary, American naval officer, planted the Stars and Stripes at the spot toward which the explorers of many nations had been struggling with consuming ambition for centuries, and saw the flag of his country floating over the goal of the world's desire. That day realized the ambition that had ruled his own soul for more than twenty years. If ever explorer deserved to succeed as reward for unexampled persistence, patience, and pluck, he did. No wonder it was difficult to realize that at last the great prize was within his grasp. It had been so nearly won before, yet had just eluded him. Year after year he had risked his life and the lives of those who accompanied him in his attempts to be first at the Pole; and now, as he stood at that mathematical point on the earth's surface, on that lone spot

> "Where no man comes,
> Or has come since the making of the world,"

and knew that the long and oftentimes fatal race for the Pole had ended, it would not be strange if he were unable to analyze his feelings. Compared with his former experiences, indeed, this successful trip was all simple and commonplace, devoid of the hairbreadth escapes and

Photograph by Brown Bros.

THE CREW OF PEARY'S SHIP, THE "ROOSEVELT"

hair-raising incidents always anticipated in a polar expedition. Yet what a wave of satisfaction must have swept over him! It was his last chance. He could not have endured another failure and another exposure to conditions that require the rapid circulation and strong resisting powers of youth. And now success had come! The message would go round the world, "Peary has found the North Pole!" That fact would be remembered to the last day of human history. He had placed his name among the Immortals.

The message was flashed round the world some months later, and sent its thrill to the heart of everyone who admires the achievement of a great deed. The world did not for a moment doubt the fact, for Commander Peary had a character and record behind his cablegram. The man who could hold to his ambition for twenty-three years, through all defeats and perils, was not one to try trickery at the end.

THE RECORD OF PERSISTENCE

Nine times altogether did Commander Peary make his way into the arctic regions, facing their dangers, discovering their secrets, overcoming their difficulties, learning how to meet their peculiar conditions, improving the methods of sledging, always coming a little nearer to the luring goal. As he said on one occasion, it was the thing that he must do, and he could not rest until it was done. And it is well said that there is nothing in all the long and terrible history of arctic exploration that compares with the determination of Peary in his protracted fight with the frozen elements. When money was lacking he lectured until the funds were forthcoming. Several times it seemed as if he had only to stretch out his hand and grasp the prize, when suddenly Nature in her sternest mood came between him and success, and drove him back, not into disappointed inactivity, but to planning and preparing for fresh effort. Whatever else may be true of him, he stands unique in the long and honorable line of arctic explorers in his unfaltering loyalty to the one object of his life, the number of his expeditions, and the merit of his achievements.

It was in 1886 that Commander Peary made his first reconnoissance of the Greenland ice cap. In June, 1891, accompanied by Mrs. Peary and a party of five, he established winter quarters on McCormick Bay, in preparation for a land journey across Greenland to the northeast. This ended on July 4, 1892, at Navy Cliff, Academy Bay, where he gained an unbroken view of the Arctic Ocean, proving

that Greenland is an island — an achievement for which he received gold medals from both the Royal and the American Geographical Societies. Returning in 1893 with a larger party, he established headquarters at the head of Bowdoin Bay, and there, on September 12, a daughter was born to him, and named Marie Ahnighito Peary. Mrs. Peary, it should be said, was as devoted as her husband, and he owed much to her willingness to share in privations which few women have ever undergone. Storm and plague among the dogs defeated this expedition. In 1896 another visit was made to Greenland, and Peary brought home the ninety-ton meteorite, which had been seen seventy years before by Sir James Ross at Meteor Island, and is the largest known meteor in the world (see picture of it in Volume I, page 43). From 1897 to 1906 the explorations continued with varying results, showing little promise of success until in 1906 he reached 87° 6′ north latitude in the *Roosevelt*, or within 174 geographical miles of the Pole, establishing another "Farthest North" record. That was the most perilous of his expeditions also, far more so than the last and successful one. Read the story in his book, which is full of fascination. Doubleday, Page & Co. have placed no more readable book than this on the market, although they have issued a great many interesting ones.

THE EIGHTH AND SUCCESSFUL ATTEMPT

Leaving New York in July, 1908, Peary started on his expedition in August, intending to be back in the United States by October, 1909, so that he kept very close to his program. He had laid his plans with a care never equaled previously. After wintering at Cape Sheridan, his sledge expedition left the stanch ship *Roosevelt*, built for him under his special instructions, on February 15, 1909, and started north of Cape Columbia on March 1. The party comprised seven members of the expedition, seventeen Eskimos, 133 dogs, and nineteen sledges, built after Peary's model. After several days of delay, occasioned by open water, they pushed forward rapidly. At various stages the supporting parties returned to the ship, the last to leave being that under the command of Captain Bartlett, which started on the home trail after the 88th parallel had been reached.

Having said good-by to Bartlett, Peary, with five Eskimos, with supplies for forty days, with the sledges and equipment in the best of condition, and with the pick of the dogs, forced the pace, sparing neither himself nor his companions in his eagerness to penetrate to the utmost point. Here and there the ice was irregular, but on the whole the conditions were fair, and no difficulties arose to bar their advance. On April 4, the 89th parallel was passed, and two days later, on April 6, Peary and his Eskimos stood at the very Pole itself. It seems a pity that he took no member of his brave party to share with him that moment of victory, but to be the one white man and American was his pet ambition.

THE POLE CONQUERED

For thirty hours he remained at this bleak, frozen extremity, exactly the same in appearance as the icy surface over which they had traveled, making observations, depositing records, and taking photographs. Leaving again on the following day, they arrived at the *Roosevelt* on the 27th, and a few months later all the members of the party returned in safety to America, except Professor Ross G. Marvin, who was drowned while returning to the ship in command of a supporting party. This was the one fatality.

Thus the quest of centuries was ended. The story of the actual discovery of the Pole seems tame beside the thrilling tales of previous unsuccessful but exciting and hazardous expeditions. After nearly four centuries of struggle in which daring and hardy men had suffered all manner of tortures and frequently met death, in which ships had been crushed like eggshells in the ice fields, and heroism had been shown in innumerable instances, at last the American who had gone through failure after failure, and experienced as much of suffering as any explorer ever knew, traveled without extra hazard or any mischance to the geographical point which the instruments indicated as the North Pole of the globe on which we live. Perhaps this is one reason why this successful expedition does not hold the public interest as closely as do other

Copyright, Boston Photo News Co.

THE SUCCESSFUL SEARCH FOR THE NORTH POLE

Top: Admiral Peary, in his Arctic costume, on the deck of his ship; his portrait, and that of his son. Below is the *Roosevelt*, in the ice pack and in harbor before the start northward.

expeditions, especially that to the South Pole, which ended so disastrously, but brought out in shining light a rare character and a noble band of brothers in misfortune.

While such a conclusion seems commonplace and almost disappointing, so much do we love to sup on arctic horrors, it must be understood that Peary had used the experience of his twenty years to guard against any mischance this time. He had prepared for every emergency. He had carefully selected his men; the dogs were the very best that could be obtained; his Eskimos, after years of training at his hands, could be depended upon for the most trying and difficult work; the sledges were packed under his direction. All his care and preparation were amply justified by the result.

There was only one doubtful element. He could not control Nature, and had to take his chance. What he feared most was the opening up of leads. At any moment the ice, seemingly solid as granite, might break up with a crack and engulf the daring party traveling on its surface; but here again he enjoyed the best of fortune. On the outward and homeward run alike, the pace was rapid and the progress better than they had dared to hope, and the feelings of all were well expressed by one of the Eskimos, in his own quaint way, "The devil is asleep or having trouble with his wife, or we never should have come back so easy."

The North Pole has been found. To what purpose, other than to record another achievement of human daring, science may tell us.

AMUNDSEN REACHES THE SOUTH POLE

On August 9, 1910, Roald Amundsen sailed from Norway on the *Fram*, the ship that had been built for Nansen. He was provisioned for two years and carried ninety-seven superb Eskimo dogs. He was bound for the South Pole! He knew that two other expeditions, one English and one Japanese, were launched on the same hazardous undertaking. In order to avoid crossing their routes he chose as his base of operations a point called the Bay of Whales, a permanent indentation in the great ice barrier that has for centuries cut off the South Pole from approach by ships. The *Fram* reached this point on January 14, 1911, after a journey of 16,000 miles through the northeast and the southeast trades, the "roaring forties," the fogs of the fifties, and the ice-filled sixties.

In a quiet nook, behind a projecting ice cape, they began to disembark and establish themselves on the ice. Here Amundsen divided his crew into two groups, one of which took the ship back to Buenos Ayres, the other the landing group. In fourteen days the landing was completed, the ready-made houses were erected, the headquarters christened "Framheim," and the *Fram* made ready for departure. A party of four men, with eighteen dogs and three sleds packed with provisions, was now sent out to explore the immediate neighborhood and establish a depot of provisions at a suitable point to the south. In four days they covered ninety-nine miles — a splendid test, both of the men and their equipment. Here they established a depot of 1300 pounds of provisions for use on their main expedition to be begun in the spring.

The return journey took only two days, a fine record for the noble dogs which were to do and to suffer so much for a cause they could never understand. After a week's rest a larger party of eight men, with seven sleds and forty-two dogs, was sent out to establish a depot still farther south. This left only the cook at "Framheim." Passing their first station, they went on to the 81st parallel and there established a second depot of 1150 pounds of provisions. From there three men were sent back, and the other five pushed on to the 82d parallel and left a third supply of 1375 pounds of provisions, after which they also returned. Later in the winter a third expedition was sent out to add to the quantity of provisions at these stations.

On April 22 the sun disappeared and the long night began. The work of the men now consisted in killing seals for the support of the dogs. A supply of 132,000 pounds of seal meat was thus accumulated. Also the experience of the excursions already made was utilized in preparing for the main advance in the spring. The sleds and all supplies were made lighter. Weeks were spent in packing the sleds for the long journey. One item consisted of 42,000 loaves of

hard bread, each of which must be handled separately!

On August 24 the sun reappeared. The winter had ended, and on September 8 the expedition was in motion. But the still unsettled weather held them back until October 20. The party was to divide into two groups, to advance by different routes. The main group consisted of five men, with fifty-two dogs and four sleds. They were provisioned for 120 days.

On the fourth day out they nearly lost one sled and thirteen dogs by a bad fall into a great crevasse. On November 17 the ice barrier was crossed. They were now on land. A due south course was decided upon, although this took them over a range of mountains, on the crest of which, after a difficult climb, they established a new depot, with provisions for thirty days.

Before them lay what they chose to call the "Devil's Glacier." It took three days to climb this obstacle, and at the top they were at an elevation of 9350 feet. Before them rose "Thervald Nilsen Mountain," with an elevation of 16,400 feet. On December 6 they reached an elevation of 11,024 feet above the sea, and this was the highest point they were compelled to cross. From this place southward their journey lay over a huge level plateau, and they reached 88° 23′ S., Shackleton's farthest south. There they camped and established their last depot, where they deposited 220 pounds of provisions.

The way now led downward. The sleds ran easily. Seventeen miles a day were covered. On December 11 they reached 89° S. Only one more degree to the Pole! They now calculated that they would reach the Pole on December 14. Of that day let the great explorer himself speak.

"December 14 dawned. It seemed to me as if we slept a shorter time, as if we ate our breakfast in greater haste, and as if we started earlier than on preceding days. As heretofore, we had clear weather, beautiful sunshine, and only a very light breeze. Not much was said. I think that each one of us was occupied with his own thoughts. Probably only one thought dominated us all, a thought which caused us to look eagerly toward the south and to scan the horizon

Copyright, Underwood & Underwood

THE FIRST PARTY LEAVING THE "FRAM" FOR PRELIMINARY EXPLORATIONS

of this unlimited plateau. Were we the first, or ——?

"The distance calculated was covered. Our goal had been reached. Quietly, in absolute silence, the mighty plateau lay stretched out before us. No other man had ever yet seen it; no other man had ever yet stood on it. In no direction was a sign to be seen. It was indeed a solemn moment when, each of us grasping the flagpole with one hand, we all hoisted the flag of our country on the geographical South Pole, on 'King Haakon Plateau.'"

Brave conqueror of untold hardships! Well does he deserve the praise of his country and the world. For three days they remained, marking the site as well as possible with cairns of stone, and taking observations.

They had covered 863 miles in average daily marches of fifteen miles. On their return journey the average march was twenty-two and one tenth miles, and they reached "Framheim" January 25. The good ship *Fram* had the honor of penetrating both to the farthest north and the farthest south ever reached by a vessel.

CAPTAIN SCOTT'S EXPEDITION AND HEROIC END

THE name of Robert Falcon Scott will live with those of the great explorers. It was his dream to discover the South Pole, and for thirteen years he devoted himself to the search. He was a rising young officer in the British navy in 1899, when he undertook the new task of exploring the unknown antarctic continent by land. He was the founder of antarctic sledge traveling. Look at his discoveries: King Edward Land, Ross Island, the Victoria Mountains, and, to crown all, the great ice cap on which the South Pole is situated. All this is to his credit. It is true that Captain Amundsen reached the South Pole first, but it is doubtful whether he could have done it without the knowledge gained from Captain Scott's previous expeditions and surveys. The Scott expeditions were scientific, and had a purpose of advancing knowledge, not merely of reaching a spot never reached before. The tragedy of Scott's death, on the way back to the winter depot, resulted in making his noble character known to all the world. No such diary as his has ever been written by any other man. His last message to his wife and countrymen will have place among the classics of heroism. Not a word of that story of the last terrible days would one wish to have changed. No complaining, no bewailing fate, no fear, but the resignation of a true, brave man, who had done all that a man could to save his party. The world will honor him, and every boy or man who reads his thrilling story will be the better for it.

The story has been told in two large volumes entitled "Scott's Last Expedition," published in this country by Dodd, Mead & Co. The first volume contains Captain Scott's Diary, which will take rank with Cæsar's Commentaries and Grant's Memoirs among the great descriptive narratives of literature. Be sure to get this and read it if you possibly can. The second volume includes Dr. Atkinson's report, showing why rescue of the Scott party was impossible, and gives the valuable scientific achievements of the expedition. For one thing, no such illustrations of polar regions were ever before secured, and the reproductions add greatly to the value of the work.

THE DIARY

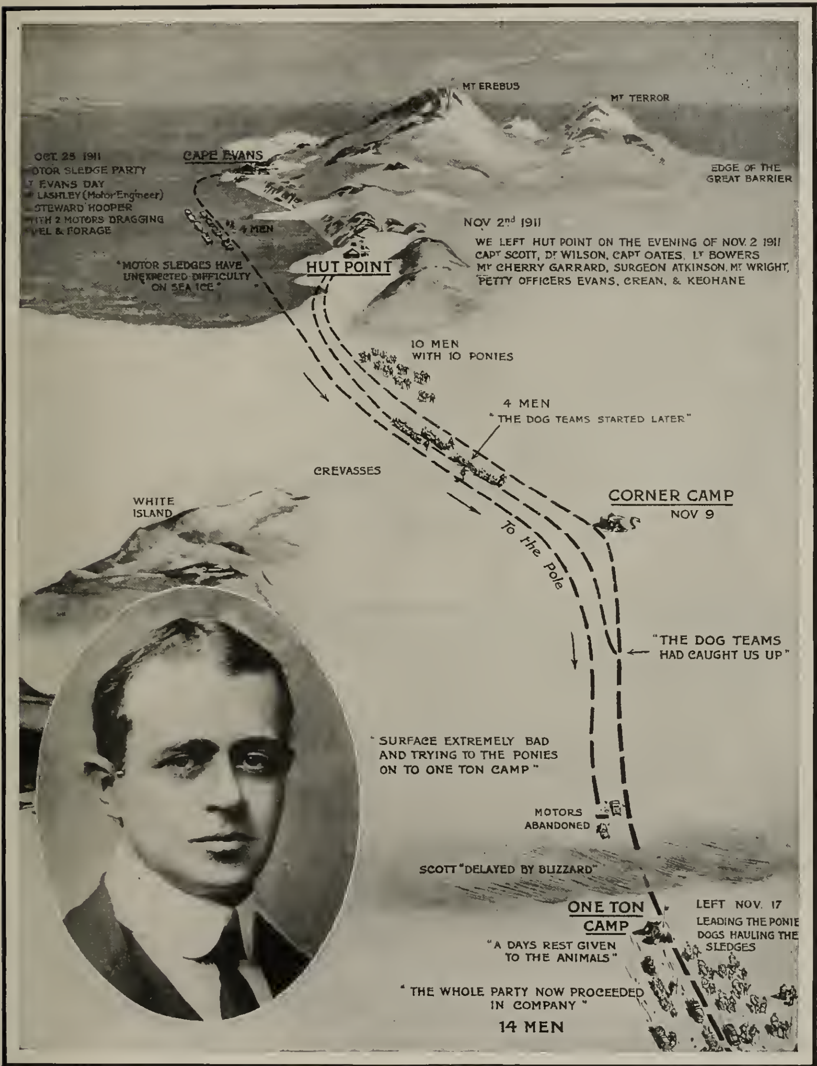
Captain Scott wrote his Diary methodically from day to day, beginning when his ship, the *Terra Nova*, sailed southward in 1910, and continuing to the moment in March, 1912, when, with two dead companions in the tent pitched for the last time in the frozen waste of the Great Barrier, the dying commander wrote: "The end cannot be far. It seems a pity, but I do not think I can write more. For God's sake, look after our people."

Published in facsimile, the last lines, although they are penciled by the hand of a man suffering physical agonies due to frozen feet and the resultant commencement of mortification spreading upward, and to acute mental distress, and almost at the actual point of death, are marked by masculine firmness and complete absence of tremor.

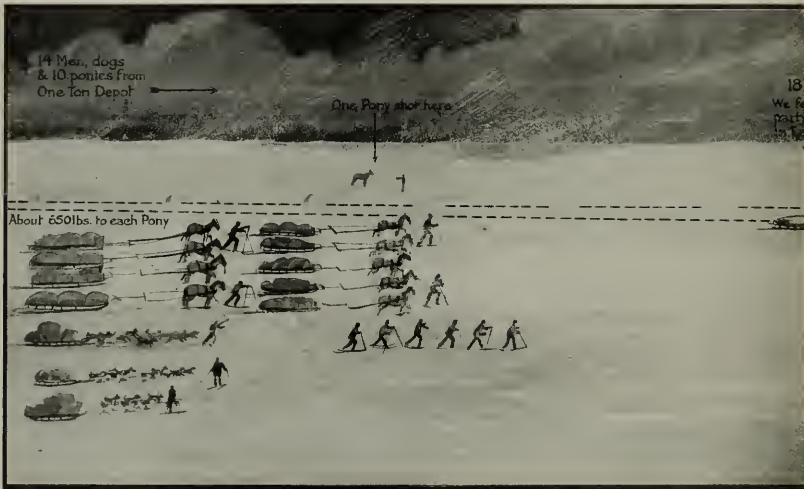
The Diary is an intensely human document, and is a constant revelation of the character of the writer. His first thought was always for the comfort of others. He was especially tender of the animals. Very soon after the expedition started, a terrible storm was encountered that came near sending the *Terra Nova* to the bottom with all on board. During all that experience the Captain writes most of the sufferings of the poor horses, crowded in their narrow quarters and thrown about as the ship rolled and tossed. He wonders if they remember such trying experiences! This note is characteristic. No wonder the men loved him, so big was his heart, so ready his sympathy. Then, he was full of buoyancy and cheer. He tells what a remarkable company he had, and how loyally and unselfishly they worked together through the long night of months, in circumstances that test men thoroughly.

THE DREAD DISCOVERY

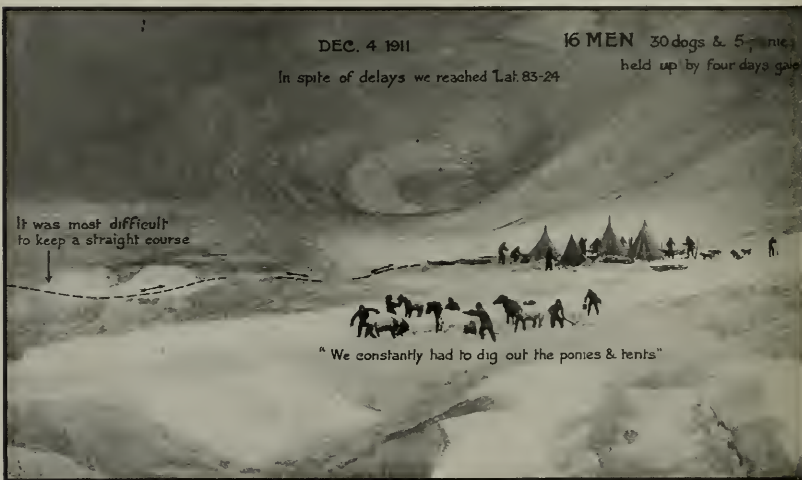
It is not our purpose to follow through the journey of sixteen hundred miles. This has been pictured wonderfully in the sketches reproduced by courtesy of the London *Sphere*. But there was one tragic moment, second only to that of the end, when on approaching the Pole the party discovered that they were not the first to reach the spot.



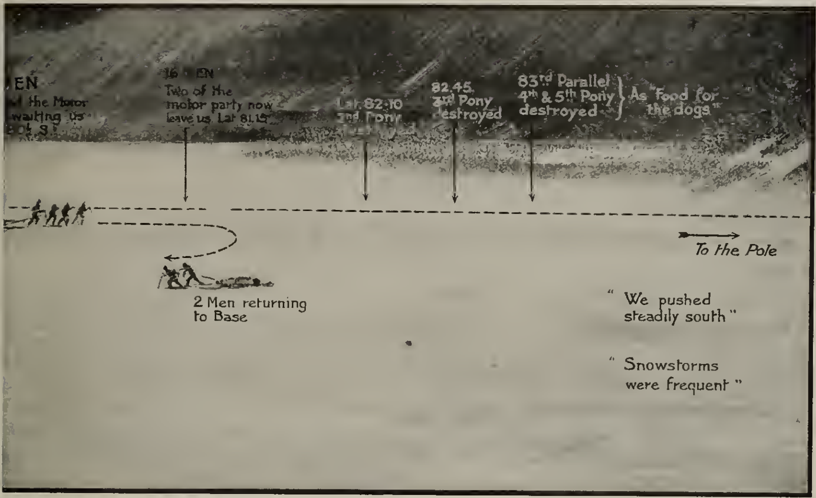
Captain Scott, and Stage I of the remarkable pictorial record of his march to the South Pole and its tragic termination.



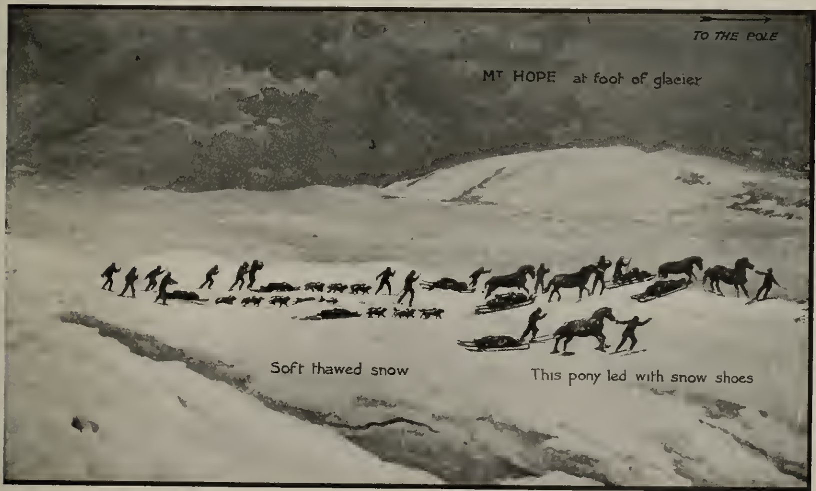
II. The main party moved forward from "One Ton Depot," with 18 men, 10 ponies and 30 dogs. One pony was shot for expediency. The motor sledges were disabled.



III. The 16 men pressed on, and in spite of snowstorms and delays were within 12 miles of Mt. Hope on December 4. Little snow cairns were built at four-mile distances as guides.



Two now left, and 16 went forward. Bad weather encountered, which grew worse. The destroyed ponies provided food for the dogs. Sky continually overcast, land rarely seen.

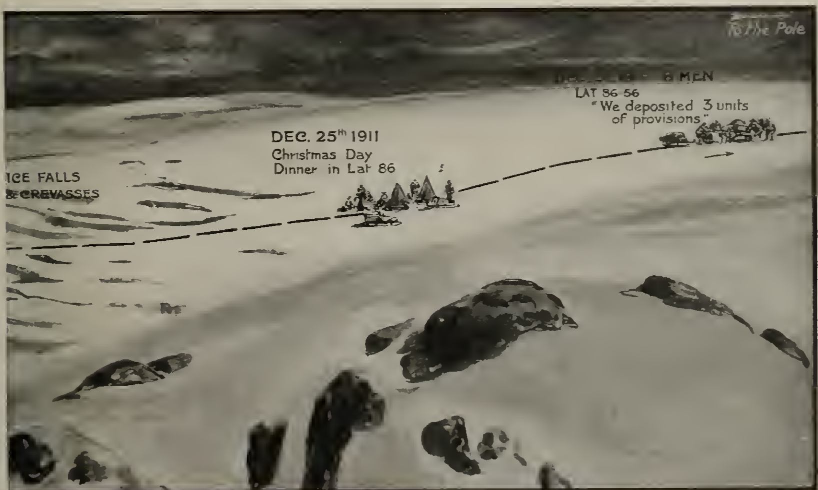


A southerly gale sprang up, lasting four days. Much snow fell; then a thaw came and "soaked everything"; but the men hauled on skis, and moved on to Mt. Hope.

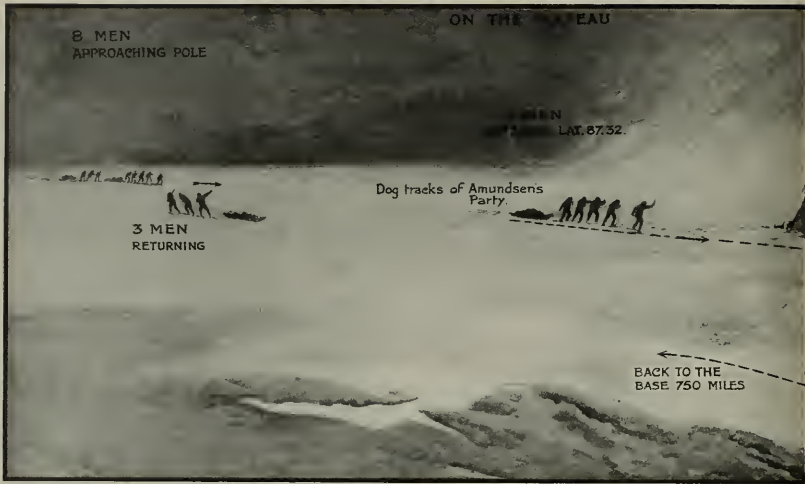
IV. "It took 14 hours to do 8 miles." Had to shoot the ponies, as there was no more food for them. The party plowed its way through soft snow over the Pass. This landed them on the glacier.

V. The 12 men now got clear of the glacier, but weather continued bad on the plateau. The upper glacier depot was formed, and 4 men left for the base. "Everybody in high spirits."

Even on the Beardmore Glacier the men sank to their knees. The dogs were sent back. The party was now reduced to 12 men. The going was very heavy, the sledge runners sinking.



Eight men spent Christmas Day on the plateau. Had an excellent dinner and a march of 17 miles. New Year's Eve the seamen rebuilt the sledges. Left provisions here.



VI. Weather good on the whole, but low temperature. Three men left the party when 156 miles from the Pole. Five men found dog tracks of Amundsen's party, and learned he had beaten them.

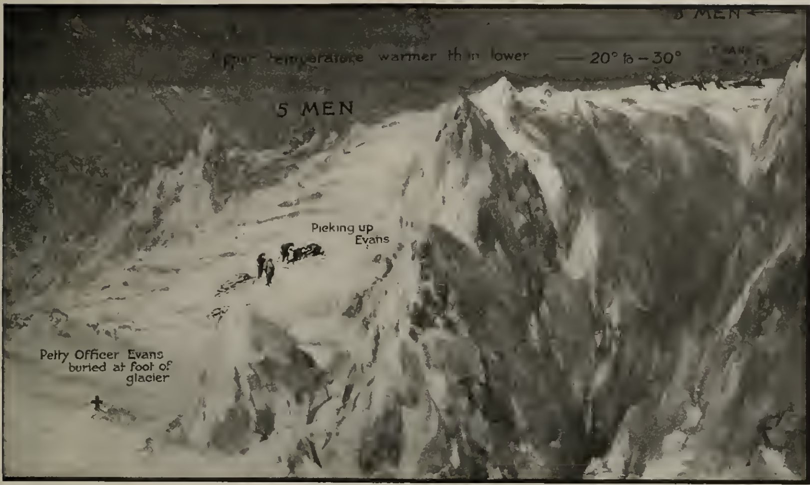
VII. The brave men start back, stopping at Cloudmaker Mountain to take photographs and do geologic work. Petty Officer Evans's condition delayed the descent. Then he fell, suffering concussion of the brain.

The heart-breaking discovery of the Norwegian flag planted at the Pole. Captain Scott is shown locating the position. The Union Jack was planted a half mile south of the Norwegian tent.

The party halted, collecting fossils from Buckley Island, a rock peak. The five men return across the plateau, making good marches in fair weather, but Evans causes more anxiety.

VIII. This stage begins at the right-hand upper corner on the next page, where " 5 men " are seen. The drawing above shows how the 4 men struggled on in the storm, with Captain Oates failing.

IX. Now comes the last stage. Here we see the three survivors, after Captain Oates has " walked away," struggling on in the blizzard to the last camp. Only 11 miles to safety, but lost.



On the right the 5 men are seen descending, drawing Evans on sledge. He dies and is buried at foot of glacier. This left them a " shaken party." The weather grew colder and colder.

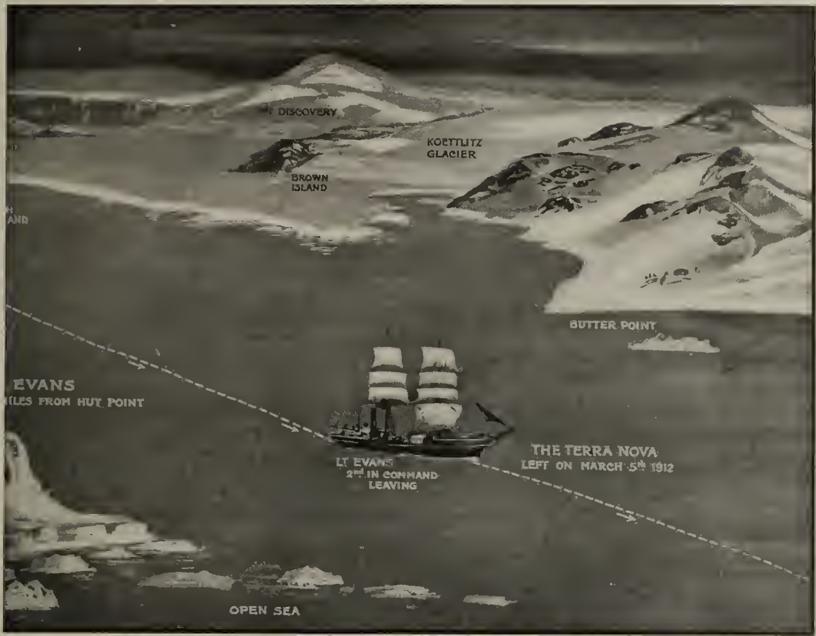
This picture chronicles one of the bravest and most pathetic incidents on record. Hopelessly ill, in order that his companions may save themselves, Captain Oates goes out to die alone.

X. The comfortable base toward which Captain Scott was struggling. The sea was now open, cutting off Hut Point from approach on the ice. Butter Point was also cut off.

That took the life out of the brave men who had faced death to discover the South Pole, and must still face it, now without heart. "We found a black flag tied to a sledge bearer. This told us the whole story. The Norwegians have forestalled us and are first at the Pole. It is a terrible disappointment, and I am very sorry for my loyal companions. To-morrow we must march on to the Pole and then hasten home with all the speed we can possibly compass. All the daydreams must go. It will be a wearisome return." Even in that hour the Captain thinks first of the disappointment felt by his companions.

Wednesday, January 17, the Pole was reached. "The Pole. Yes, but under very different circumstances than those expected. We have had a horrible day. Head wind, with temperature 22 below zero, and companions laboring on with cold feet and hands." From this time on it is a story of despair, not told in a gloomy or hopeless tone, but giving facts that prove how the gates of hope were slowly closing. Human courage and endurance were tested to the limit, and only the endurance failed, in one after another. Surely a more pathetic story was never told. It fills one with admiration and pity commingled. "Now for the run home of 800 miles and a desperate struggle. I wonder if we can do it."

January 21 came the blizzard. Then Evans, the giant of the party, began to give out. This was a stunning blow. Here are some entries: "We are getting more hungry. . . . It is monotonous work. . . . Wilson has strained a tendon in his leg. . . . Evans' hands are really bad, and to my surprise he shows signs of losing heart over it. . . . Feb. 12: In a very



Lieutenant Evans, after an almost fatal illness, was leaving on the "Terra Nova," as delay would have endangered the return to New Zealand. Captain Scott reached his last camp March 21.

critical situation. . . . Not going strong — probably none of us. . . . March 3: Can't keep on at this. Amongst ourselves we are unendingly cheerful, but what each man feels in his heart I can only guess."

The death of Evans was a terrible thing to the party, but his illness had delayed them until it was too late for any of them to reach safety. Then came Captain Oates's breakdown through frostbitten feet, and by March 11 he was near the end. The picture of the brave man, realizing that he cannot go farther and that it means death for the others to stay by him, as he bids his comrades good-by and walks out into the blizzard, is one to remember. Finely the Diary says of him: "Oates's last thoughts were of his mother, but immediately before leaving he took pride in thinking that his regiment would be pleased at the bold way he met his death. We all hope to meet the end in a similar spirit, and assuredly the end is not far."

It was not far. The blizzard held them in its relentless grip, only a few miles from rescue. But rescue was not to be. In his final moments of consciousness, Captain Scott, lone survivor, wrote letters to friends and relatives. In the last letter that he addressed to his wife he sent this remarkable message: "Make our boy interested in natural history if you can. It is better than games. Keep him in the open air. Above all, you must guard him against indolence. Make him a strenuous man. The great God has called me. Take comfort in that I die in peace with the world and myself and am not afraid."

So long as the world has men of such character its progress is certain.

Copyright, Underwood & Underwood

VILHJÁLMUR STEFÁNSSON

ARCTIC STUDIES ON NEW LINES

THE story of the white man's conquest of the polar regions would not be complete without a brief notice of the great work that is being carried on by Vilhjálmur Stefánsson, more especially among the peoples of the arctic zone. This young explorer has led a number of expeditions into the frozen north, beginning with two to Iceland in the interests of archæology in 1904 and 1905, followed by trips to the mouth of the Mackenzie River and northern Alaska, and later excursions into the forbidding confines of the arctic circle as far as Dolphin and Union Straits and Victoria Land. In all his travels Stefánsson has held to one main principle: that if the land will support any human beings, it will support him. Advancing on this plan, he "lives on the country," as he expresses it, and so far the country has satisfied his needs. Particularly pertinent here are his references to Sir John Franklin, of whose expedition he has found numerous traces. Among other things he says:

"That the country where Franklin's men starved is sufficiently provided with means of subsistence is shown by the fact that it was peopled by Eskimo both before and after that great tragedy. At the very time when these Englishmen were dying of hunger, there were living all about them Eskimo families who were taking care of their aged and bringing up their children in comparative plenty, unaided by the rifles and other excellent implements which the Englishmen had in abundance." [1]

Stefánsson has one great advantage, that he can meet the Eskimos in more familiar fashion than probably any other white man. He speaks their language in a number of dialects; he can hunt game in approved Eskimo style or arouse the enthusiasm of the natives by his own superior methods; and he can spend the long winter months in comfort in an Eskimo dwelling, always making the most of his time by studying the speech, characteristics, superstitions, and religious beliefs of his dark-skinned friends.

THE BLOND ESKIMOS

It was during an important expedition which lasted from 1908 to 1912, which Stefánsson conducted for the American Museum of Natural History of New York and the Government Geological Survey of Canada, that a hitherto unchronicled tribe of northern people was discovered. Instead of the swarthy complexion of other natives of the region, these people were distinguished by fair skins and light hair, and the men by their light-brown beards. They were as interested in the explorer as he was in them, and quite naturally, as until the arrival of his party they had never seen a gun, but used only bows and arrows and weapons dating back to the Stone Age. Their habits and beliefs were as far behind the times as their weapons. Stefánsson graphically describes his feelings among them as similar to those of Mark Twain's Yankee visitor to the court of King Arthur.

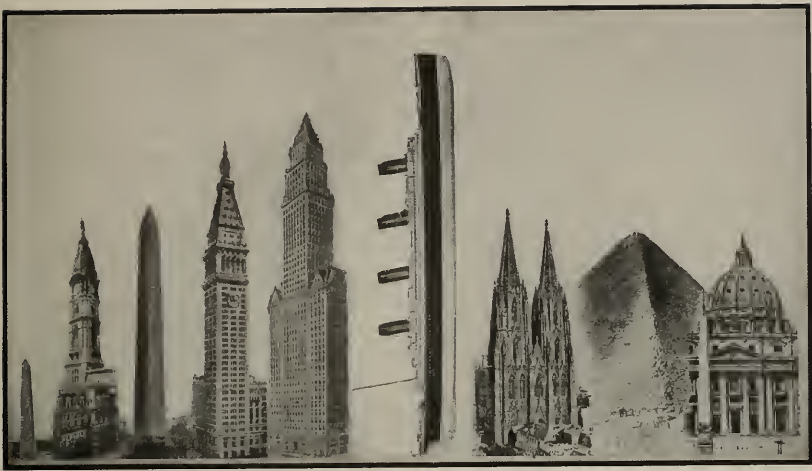
The work of this earnest student and intrepid explorer well complements that of Franklin, Kane, Nansen, Amundsen, Peary, and other heroes, and his efforts for the advancement of various branches of science are certain to win him a steadily increasing renown.

[1] "My Life with the Eskimo," page 305.

Courtesy of Denver & Rio Grande R.R.

THROUGH THE ROYAL GORGE, GRAND CAÑON OF THE ARKANSAS, COLORADO

The mountain walls here are a half mile high, forming the most remarkable chasm in the world through which a railroad passes.



LENGTH OF A STEAMSHIP COMPARED WITH THE HEIGHT OF STRUCTURES

Bunker Hill Washington Monument Woolworth Cologne Cathedral St. Paul's, London
City Hall, Philadelphia Metropolitan Olympic Pyramid of Cheops

MAN'S ACHIEVEMENT AS A BUILDER

FROM THE BEGINNING IN TREE NESTS, CAVES, AND HUTS TO THE TWENTIETH-CENTURY SKYSCRAPER

ONE of the first things man did was to contrive some kind of shelter or house. Even the animals do that, and do it very well. Can you imagine anything better for its purpose than such a nest as the Baltimore oriole weaves, or the carefully built home of the beaver? Some savages in hot countries are still content with no better habitations than an overhanging rock on the sunny side of a cliff, or a hut of branches or grass or palm leaves that does not compare in skill with many birds' nests or with the winter lodge of the muskrat; but most men *wish* something better. The beginnings of something better are found, in Europe, along the shores of the Mediterranean. With the cave homes we have become familiar in Volume I (page 300). A more civilized way of living came with the people of Asia who in the course of time moved into southern Europe and there built homes for themselves.

THE ROOF AS A SHELTER

What is the principal purpose of a house? Shelter, is it not? Then its most essential part is the roof. That is what the savage seeks to make when he spreads leaves or bark over the branches which he sticks in the ground, bending them toward one another and tying their tops together. But it is low, and if his thatch is heavy enough to prevent leakage in a storm, it crushes the hut still lower. Various improvements suggested themselves, in order to get more room. One of these was to dig away the ground under the hut; and you may find remains of such houses in British Columbia, where a deep pit was roofed over with logs sloping from its rim to a central group of four posts, the space between which was not only the chimney, but the house door, the occupants going in and out through the smoke by a notched log. This is the simplest form of dome.

A better way was to lean the poles and brush against a pole resting in the crotches of two adjacent trees or in two crotched posts—a form we still imitate in our A-tents, using canvas instead of branches of trees. This was a roof resting on the ground, easy to build and good enough for a day or two in a summer camp, but too low and small for permanent comfort. The next step was to put supports under the roof, lifting it high enough for people to stand or walk about beneath it. The forms of houses to which this led varied, the difference being mainly between methods in a forested and more or less rainy or snowy region and those in an open and dry part of the world, where wood was scarce but rock and earth were plentiful.

ROUND HUTS

Let us see what a man would do who tried to build an improved home for his family in a forested and damp country. If he had been used to seeing pits covered over, or pointed huts, he would set his posts in a circle, with one or more in the center to support a conical cover. Many Central African tribes make just such houses to this day, thatching them and covering their walls with grass.

The Mandan Indians of the upper Missouri dwelt in clay-covered huts which were slightly vaulted and provided with a sort of portico. In the center of the roof was an opening for the exit of the smoke. Four pillars near the middle, with several crossbeams, supported the roof. The dwelling was covered outside with matting made of osiers, over which was laid hay or grass and then a covering of earth.

THE ADVANCE TO A SQUARE-CORNERED HOUSE AND THE TRUSS

But the primitive builder with advanced ideas, whom we are imagining, found he would succeed better if he set a tent-shaped shelter on posts and so made an oblong, square-cornered house. He would plant a post for each corner,

A SKIN TENT, USED BY HUNGARIAN HERDSMEN

This shows the pointed roof. An example of the round hut is shown on page 361, Vol. I.

A NAVAJO HUT

In this hut can be seen the transition from the round to the oblong house.

and would choose posts with a crotch at the top, because he must lay a strong pole or beam from post to post along each side of the square to hold up the eaves of his roof. Then he must set two taller posts in the middle of each end to carry the ridgepole. Having done this, he would place his sloping rafters, tie poles across them lengthwise, lay above this framework a cover of sheets of bark or a thatch of grass or great leaves, and then, if he pleased, construct outer walls of similar materials, and his house would be done. Houses made wholly of logs are still used in wooded frontier places.

But after a while he would notice that his ridgepole was sagging and his side walls and posts were being pushed outward by the weight of the roof. He might then conclude to build a new house, labor and materials being very cheap in the woods. This time he would tie the sides together, to prevent their spreading, by beams laid across the ends of the framework at the top of the posts, as well as on each side, firmly lashed or pinned at each end. Having done so, he would see that an upright resting on the middle of each end beam would support the pole, saving the use of the tall stick before employed. In doing this, however, he has done more than simply to save timber and strengthen his frame, for he has invented the *truss* — the most important device in architecture. Now his ridgepole, if of reasonable size, will not sag, because the side beams resist the push of the rafters against them and do not tend to spread, because held in place by the end beams; and these, in turn, are prevented from sagging under the weight of the center of the roof which they carry, because the heavier the pressure on the side beams, the harder these pull to hold the end beams (or ties) stiff and straight. The frameworks by which men later supported the roofs of great halls or spanned wide streams are more complicated forms of this simple truss.

WHY THE OBLONG HOUSE IS BETTER

In this possibility of enlargement is the great advantage of the square-cornered building over the round one. Oblong buildings can be built to almost any size — or at any rate as *long* as you please. They were often made in barbarous lands to house whole communities; and this was advantageous socially, because it helped to bind people together into a settled village and national life, where industries and arts could be developed. The "long house" of the Iroquois is a good example.

THE BEGINNINGS OF BRICK BUILDINGS

Shelters of rough stones mixed with mud, earth houses, and dugouts have been used from time immemorial. In warm climates cottages have been made of willows plastered with sticky earth, and bamboo and other materials have been used ingeniously. Mold the mud into square chunks of uniform size, harden it in the sun, and you have the crude or "sun-dried" bricks which were the chief building material in the earliest region of civilization, which spread from the Euphrates valley to the Nile. Buildings of brick indeed are traced back in Chaldea and Babylonia to before the year 4000 B. C. The first improvement of such simple huts was made in Egypt, by using trunks of palm trees as a lintel over the doorway, to support the wall above and to cover over the hut and carry the flat roof of earth.

To make these crude bricks, the clay was first freed of grit, stones, and lumps, then mixed with finely chopped straw; next a fixed proportion of water was added. The mass was then kneaded with the feet in shallow basins and thrown into molds from fourteen to fifteen inches square and from two to four inches thick. You remember that the complaint of the Israelites in Egypt was that they were required to make bricks without straw.

THE REMARKABLE BUILDING WORK OF THE AMERICAN INDIANS

The Pueblo Indians, living in the valleys of the Rio Grande and the Colorado, invented precisely similar sun-dried bricks and made houses of them which far surpassed in architecture anything else in North America, some of them, still in good condition, being hundreds of years old.

They formed their mud bricks, which the Spanish explorers called "adobes"[1] (a-do′-bes), not in molds, but by hand; first as a ball of kneaded clay mixed with ashes (not straw), and then patted by hand into a brick about eighteen inches long by six wide and thick. After a wall of this had been laid up, it was smeared all over with a coating or stucco of mud. The roof was flat and composed of heavy beams of wood upon which was laid a floor of poles covered with a thick layer of packed clay. Just such houses are made there now by the Indians and Mexican farmers.

A PRIMITIVE SKYSCRAPER

These Indians were peaceful farmers, but on account of tribal quarrels and raids from the more savage Indians north and east of them they were obliged to have fortresslike community houses, easily defensible. These big tenements were called *pueblos* or "villages" by the Spanish explorers who visited them from Mexico in the sixteenth century, and the people were named Pueblos, regardless of tribal distinctions. Most of the villages were built of stone, but where stone was scarce adobe was used. The finest example of this type is the great pueblo of Taos, New Mexico, still standing and occupied among the western foothills of the Rocky Mountains. On each side of a little mountain stream is an immense adobe structure, rising by successive steps until an irregular pyramidal building seven stories high presents an almost impregnable tower. This was the origin of the skyscraper idea. Each story is divided into numerous little compartments, the outer tiers of rooms lighted by small windows in the sides, while the interior are dark and used chiefly as storerooms. The only means of entrance is through a trapdoor in the roof, and the ascent from story to story is made by means of outside ladders which are drawn up at night. For packing people closely

[1] The ancient Egyptian name for an unbaked brick was *tob*. This, descended into the Arabic, became (with the article) *at-tob*, and thence was adopted into Spanish as *adobe*. It is now used not only for the sun-dried bricks, but also as an adjective for the style of work, and for the sticky soil, composed largely of volcanic materials, which is characteristic of Arizona and New Mexico.

MEXICAN HOUSES OF THE PRESENT DAY

together, the tenements remind you of the modern apartment houses.

FIRE-BURNED INSTEAD OF SUN-DRIED BRICKS

The making of fire-burned bricks was not known in America until Europeans came to teach it. Fired bricks were used in Babylonia and Syria, however, as far back as we can trace architecture. The stamping of the maker's name on the bricks has enabled archæologists to tell the age of ruined buildings which contain no other clew. Besides the regular-sized burned brick, others were molded in special shapes and sizes — segments of circles for use in columns; wedge-shaped for arches; triangular for corners. The bricks were laid in liquid clay, lime mortar, or bitumen. In building the walls of Babylon, clay from the trenches was used in making the bricks, and between every thirtieth course of bricks mats of woven reeds were placed. Read, in Genesis 11 : 3, how the Tower of Babel was built. Enameled brick was also used by the Babylonians and Assyrians, and it is interesting to note that this kind of brick is coming into use in the finest buildings to-day.

WONDERFUL PREHISTORIC BRICK STRUCTURES

Beneath mounds of sand in Mesopotamia there have been uncovered proofs of a civilization which demanded of engineers, architects, and builders results as difficult and perfect for their purpose, considering the difference in materials and circumstances, as any which have been accomplished since. At Nippur, the religious capital of the earlier period of Babylonia, there have been traced the lower parts of a temple of Bel — the reigning deity of the Babylonians — six hundred and fifty feet square. It was surrounded by a huge wall of unbaked brick with towers at the corners, and is still in places sixty feet high and fifty feet thick at the bottom. Upon and within the wall were passages and chambers. These included libraries of books in the form of inscribed tables of hardened clay.

"The most striking feature of this building," says Dr. Peters, "was the ziggurat," or high place, referring to the towerlike elevation. "Ziggurats stood for mountains, and represented the ancient primitive ideas of a people who had once been dwellers among hills and had grown accustomed to worship 'in high places,' as nearer to heaven. There were no hills in the plain of the Euphrates, and hence an artificial one must be built to satisfy their sense of religious propriety.

"The small brick structure that crowned the ziggurat was the mysterious dwelling place of the unseen god, similar in idea to the Holy of Holies of the Jewish Temple of Jerusalem. Such were the origin and meaning of the ziggurat or high place. The only other region, so far as known, in which similar structures have been discovered, is southern Arabia."

Such temple towers are found in various ancient city sites, but none surpassed that built at Borsippa, a suburb of Babylon, which is supposed to be that called in the Bible the Tower of Babel. It was restored to unwonted magnificence by Nebuchadnezzar, under whose reign, in the fifth century before Christ, Babylon reached the height of its power and glory, illustrating most completely what can be done with brick as a building material, for wood or stone was little used there. It was Nebuchadnezzar who built the wonderful seven-towered pyramid to the god Bel. Upon the platform rose the seven elevations, each sacred to its own planet, for that was the day of astrology, when stars were supposed to have much to do with life and destiny. The first stage was painted black, the second white, the third orange, the fourth blue, the fifth blood-red; the sixth was coated with silver, and the seventh covered with beaten plates of gold. The grandeur of such a structure can scarcely be imagined. Even more noted in the Babylon of those prosperous days, when Daniel was the highly trusted counselor of the monarch who afterward became so pitifully insane, were the "hanging gardens" which he built for his fretful and coquettish wife, Amytis, a spoiled daughter of the Medes, who pined in that flat land for a sight of her native mountains.

THE USE OF STONE IN BUILDING

The use of stone is a long story, ranging from the shepherd's hut to fortresses, castles,

EGYPTIAN CARVINGS, FOUND ON RUINS OF TEMPLE WALLS

magnificent cathedrals, and the splendid public buildings of all nations that have cultivated architecture.

The first step would be to pile up loose stones into a rough wall and put some kind of rude cover on for a roof to keep the rain off. Next would come the filling of the chinks with small stones or clods of earth to keep the cold drafts out. Now there was a house, and one that would stand long enough to become a home. Let a few families build such stone houses in a cluster, for common protection, and you have the beginning of a permanent village or community.

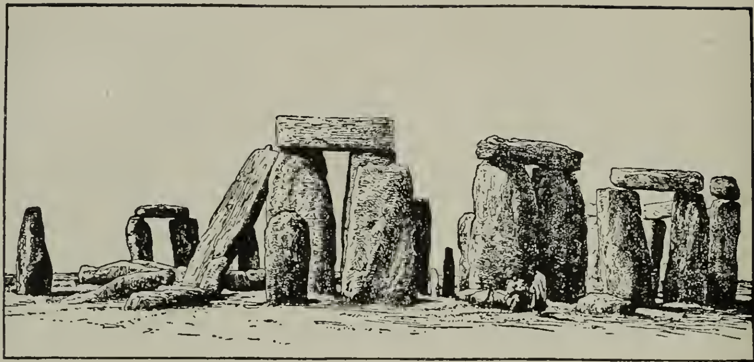
EARLY STONE HOUSES IN AMERICA

An interesting example of stone-house building by a primitive people is that of the Pueblos. In the northern part of their territory, along the courses of the Colorado and San Juan rivers and their tributaries, the houses were usually made of sandstone, which was easily gathered in loose slabs or quarried with little difficulty; and they were often built upon high "mesas," familiar to us by pictures of Zuñi and Moki towns. In ancient times the ancestors of these people made their homes in the hollows and on the ledges of the cañon walls, where they were safer from attacks than they would be down in the valleys. The ruins of these prehistoric cliff dwellings occur throughout the mesa region of northern New Mexico and Arizona and the neighboring borders of Colorado and Utah, and are not only most picturesque, but excellent examples of architecture in stone unaided by metals, tools, or lime mortar.

There are many parts of the Old World where the peasants — the poorer country people — still dwell in houses scarcely better than those of the mesas. You may see them, standing alone or clustered in villages, in all the mountainous parts of China, India, Persia, Turkey, and the Balkan countries, and also in Scotland and Ireland and France — wherever, indeed, stones and turf are plentiful and wood or brick is rare or costly.

LESSONS STONE BUILDERS LEARNED

Experience with these stone huts soon taught the early builders some things in the way of improvement, while others were learned slowly. It must have been an early discovery, for example, that stones with flat surfaces would make a much better wall than rounded ones; that the bigger the stones the better, as a rule; that it was worth while to knock off rough corners, where that was possible, and try to fit the stones to one another; that walls closely chinked with mud were not only tighter but stronger; and that some kinds of earth, as sticky clay, were better than others for this purpose.



MASSIVE STONES OF THE ANCIENT CIRCLE AT STONEHENGE

Here was born the idea of mortar, perfected when somebody discovered the value of mixing lime with the mud — but that somebody must have lived as long ago as the uprising of Babylon, for at that time excellent lime mortar was used.

That the first of these improvements was learned early in building with stone is plain from the character of the oldest structures of which we have any knowledge — structures which were old to the people who themselves lived in the dawn of written history, and the building of which they usually attributed to divine beings of supernatural strength.

STONES FOR BOUNDARY MARKS AND TOMBS

Great stones have been set as boundary marks, or as the representation of a holy place, since the earliest times and in all parts of the world. The Old Testament contains references (as in Genesis 31: 44–55) to many such in the land of the Jews. In primitive Europe the corpse or the ashes jar of a distinguished person was placed after death in a sort of chamber or chest of massive slabs of stone set on edge and covered with similar slabs, after which the whole affair was buried under a mound. These mounds have in many places, and especially in western France, been swept away by vandalism or the weather, and their interior stone chambers are exposed, standing like the dining tables of giants above the surface of the ground. This custom lasted on from the Stone Age down to the threshold of modern conditions.

EGYPTIAN BUILDING WONDERS

The Chaldeans and Babylonians erected huge buildings, but they made them of wood or clay. When the Egyptians began to imitate these structures, they used the new material, stone, which they saw was superior to earthenware or timber. It is not strange that they should at first have tried to use it in as large pieces as possible. All the building stone of Egypt had to be quarried. It was easier to take it in blocks.

From the quarries of Turah, nearly opposite Memphis, came the fine white limestone used for mastabas, pyramids, and statues, and alabaster was obtained in the same neighborhood. Sandstone was obtained from the quarries near Gebel Silsileh; and near Assuan, where the great modern dam has just been completed, was quarried the beautiful red granite used for obelisks, columns, statues, and doorways, and for other architectural and artistic purposes. Although working with inferior tools, the Egyptian artisans handled the hardest stones in a manner unsurpassed in modern times. Their cutting was done with a small metal chisel and a wooden mallet, and they obtained a fine polish by rubbing with pieces of quartz or with quartz dust.

With such materials and these inadequate means the Egyptians erected those astonishing edifices, the Pyramids — the oldest buildings in the world that remain even approximately perfect, and an imperishable record of human achievement when man's muscles were almost unaided by machinery.

Herodotus says that the Great Pyramid took thirty years in building — ten of them for the transportation of the stones — and employed a hundred thousand men. Near the three smaller Pyramids is the figure known as the Sphinx, which is perhaps the greatest riddle of the world. Mystery certainly infolds these monuments of human genius and patience, but amazement is the chief feeling when one ponders over the science and art involved in their faultless construction, and remembers that they have seen the old Memphite empire, the Shepherd Kings who overwhelmed it with barbarism, the new Theban empire, the Persian, Macedonian-Greek, Roman, Mohammedan, French, and Turkish governments come and go, and now look imperturbably down on the British flag and the motor car of curious republicans. They have stood, as Humboldt reminds us, while even the heavens themselves have changed, for they were five hundred years old when the Southern Cross disappeared from the view of the savages of northern Europe; and an observer on one of their summits may have been the first to welcome the polestar as it rose above the northern horizon to shine for the first time upon these symbols of stability which are also marks of change.

Besides the Pyramids, the most notable architectural remains of Egyptian civilization are the temples, a number of which have been preserved along the valley of the Nile by the unusual climate. Some of the most noble remains of Egyptian architecture are now disappearing, because of the raising of the level

COLUMNS IN AN EGYPTIAN TEMPLE

of the water in the valley by the construction of the large dam at Assuan. It is interesting to contrast the details of Egyptian architecture with those of other countries. As with the Greeks, the stone lintel marked the principal means of roof support. Consequently the columns were large and heavy and placed close together. The shapes of the columns were obviously suggested by the palm or other native vegetation of the country.

WHAT CRETE WAS DOING WHILE EUROPE WAS STILL IN SAVAGERY

In the island of Crete, in the eastern Mediterranean, there developed among the Aryan race, at about the same time as in Egypt, a civilization of a high order, while Europe was still in savagery. Explorations made since 1900, under direction of Arthur J. Evans of London, have resulted in discoveries which astounded the world, as showing what power and culture had been achieved by men about the time when, according to Bishop Ussher's chronology, the earth was created. Excavations at Phætos and other sites have proved that the whole island was thickly peopled and dotted with cities connected by well-made roads and furnished with improved ports. This Cretan civilization traces back to the Stone Age; it was brought to a sudden end about 1400 B. C. by an invasion from the east, when the palaces were burned and the island laid waste. No brief account can fairly picture the buildings uncovered, the treasures of art in carving, in painting upon plaster, and in fashioning pottery and metal. The palace at Knossos was more like a compact town than a residence, with its two groups of buildings separated by a paved street and great central plaza. Some buildings were several stories high, rising in terrace above terrace, with flat roofs. Impressive indeed must have been the wide and spacious courts, the stately porticoes, the noble stairways, and the wealth of color everywhere displayed in this building, which was not only the king's residence, but also the administrative center of a whole empire.

At this early stage of human progress, the various branches of industry had become fairly separated and a variety of tools was employed in the crafts. A whole carpenter's kit was found concealed in the cranny of a house, left behind when the owner fled. He used saws, long and short, heavy chisels for stone and light for wood, awls, nails, files, and axes; and in shape the tools were so much like those of to-day that they furnish one of the strongest links between the first great civilization of Europe and our own.

THE GREATNESS OF GREECE

Next Greece arose as the mistress of the world. She emphasized intellect rather than force of arms, and as a builder made beauty supreme, whether of body or temple. The center of her glory was Athens, still unsurpassed, even in its ruins. The beauties of the capital were concentrated upon and about the Acropolis, that bold crag under the protection of whose fortress the city had grown from a primitive settlement of shepherds.

Chief of the buildings on the Acropolis was the Parthenon or shrine of Athena, which the critics of all schools agree in considering the most nearly faultless in design and execution of all buildings erected by man. This shrine, which was designed by Ictinus and Callicrates, was built about 440 B. C. It is Doric, the fine marble blocks fitted together so nicely that the joints are hardly visible. It measures 220 by 100 feet. The *cella*, or body of the building, was surrounded by a portico of columns, of double depth at the ends, so protecting the walls that they could safely bear the decorations in sculpture and painting. The famous frieze, representing a festival procession of horsemen and others to the temple, was a band along the top of the cella wall. The pediments were filled with great figures, taken away to the British Museum by the British ambassador, Lord Elgin, in 1812, and now preserved there as the "Elgin marbles."

Other noble temples on the Acropolis are the Erechtheum, with its wonderful colonnades, and the temple to Nike Apteros, the "Wingless Victory." Entrance was through a splendid gateway of stairs, columns, and templelike porches, the Propylæa, worthy of the great group to which it led.

THE TEMPLE OF WINGLESS VICTORY

This temple with its beautiful Ionic columns stands at the head of the stairway leading up to the Acropolis.

CHARACTERISTICS OF GREEK ARCHITECTURE

The style of architecture attained at the height of Grecian civilization is characterized by columnar porticoes sustaining a roof with a very low pitch, surrounding a massively walled rectangular building receiving but scant light from the exterior. Almost without exception these were temples, in which the sacred mysteries could be enacted in the dim, emotional gloom that would enhance their beauty. They were also used as the treasury or strong box of the community, a purpose that was the better fulfilled by the solidity of the construction. Apart from the cylindrical or fluted columns and the flowing reliefs employed for decoration, there were no departures made from the severity of the straight line. Accordingly the outline of the building was severely and absolutely simple. Yet the perfection and refinement attained by the Greeks have been the despair of all architects since their day.

THE PARTHENON

Upon studious investigation it has been found that not a line of these structures is absolutely straight; that owing to the tendency of the eye to feel that an absolutely straight edge is curved, the Greeks calculated the exact degree of curvature which would offset this tendency and give the impression of true levels and perpendiculars. Not merely the broad bases and roof lines were delicately determined in accordance with this principle, but the supporting columns bulbed very, very slightly, instead of being cut to a perfectly straight line from base to capital. Furthermore, these column shafts tapered delicately toward their top.

The Greek sense of beauty created a school of sculpture that surpasses any efforts since their day. To relieve the severity of their buildings these sculptors produced statues and reliefs to be placed upon the walls of the building, behind the columns and near the roof, as well as in the gable ends, or pediments. The capitals crowning the columns, which in some developments

of this type were very plain, in other styles received delicate elaboration, and the columns themselves, at first cylindrical, were later fluted for the sake of the additional beauty gained by the resultant play of light and shade.

To-day we often employ Greek architecture in such public buildings as banks or civic offices.

THE DISCOVERY OF THE ARCH

The Romans, as conquerors of the world, absorbed, as far as so practical and hard-headed a nation could be expected to do, the best of the culture of the nations they vanquished. Rarely did they add to or adapt their imported ideas, yet in the case of building construction they did introduce one feature that is particularly characteristic of their work. This was the arch. It does not appear in a complete form before the Roman conquests, and even long after their supremacy was established it is used only in works inaugurated and controlled by them. Apart from the combinations that they made of this feature with the Greek styles, the principal examples of arched structures are the numberless aqueducts and bridges, the amphitheaters, and the triumphal arches, whose ruins form the most imposing feature of many a European town.

ARCHITECTURAL ROME

When Rome became mistress of the world, that conquest made her envious of the splendid products of genius found in her subjugated states, and the wisest teachers, architects, artists, and artisans of Greece and other countries were invited to Rome, or taken there as slaves, to help create an imperial city on the Tiber. It would take a volume to portray the grandeur of Rome under the Cæsars. Men travel from all parts of the world to see the ruins and public works of Rome, for its monuments represent the high-water mark of achievements in architecture and art before Europe sank under the dark flood of disaster which followed Rome's fall.

The center of life in imperial Rome was the Great Forum, which lay in the hollow between the Palatine and Esquiline hills. In this place were located the principal and oldest temples, the governmental offices, the Curia (Senate House), the courts of law (basilicas), the revered circular house of the Vestal Virgins, and so many memorial arches, monuments, and statues that from time to time some had to be removed to make room for traffic and the public meetings which crowded the Forum whenever a crisis in politics or religion arose or some festival was to be enjoyed. The melancholy remains of this storied space that have survived the rage of barbarous invaders, the sweep of fires, and, worst of all, the hammer of the medieval lime burner, show what splendors must have met the eyes of the populace of the ancient city.

The Rome of earlier times had been a big but squalid sort of city, with narrow, crooked streets, badly paved and dirty, unlighted at night, and frequently on fire, for the houses were mainly of wood and there was little or no water supply. A few grand temples had been erected, but little else until Pompey (106–48 B.C.) constructed the first stone amphitheater. Julius Cæsar (100–44 B.C.) enlarged the Great Forum, and made another, and planned other ambitious improvements, many of which he carried out.

To Agrippa (63–12 B.C.) Rome owed the restoration of several old aqueducts, and some new ones, and also, among other public works, the erection of the original Pantheon. This was a temple dedicated to all the gods. It was a rectangular edifice with a porch of "sixteen superb colossal Corinthian columns." "The Pantheon," declares an eminent critic, "is the noblest work of Roman architecture. It consists of a circular hall, one hundred and forty-two and one half feet in internal diameter, supporting a dome rising to one hundred and forty-two feet, and pierced at the summit by an opening twenty-seven feet in diameter — the only window in the edifice, but wonderfully effective in its effect of interior lighting. Seven niches for statues adorn the interior, which, however, has lost much of its original aspect since the 'restorations' of 1748–1756. The Pantheon, often called in Rome 'La Rotonda,' has been since 608 A.D. a Christian church."

Augustus and his successors did much to beautify the Forum and the Palatine Hill. The palace of Augustus was a marvel of luxury.

Rome still remained an ugly and unhealthful city, outside its central magnificence, until its burning in the year 64, when Nero was emperor and is said to have fiddled while his capital was being destroyed. Now he had a chance to transform Rome into a well-ordered capital, and perhaps for the first time a government commissioned architects to lay out a plan of streets, straight and wide, crossing one another at right angles. This design is due to Celer and Severus. A law was passed prescribing the maximum height of buildings and the space that must be left between them. Thus a greater Rome arose from the ashes of Nero's fire — that imperial Rome whose grandeur still dazzles the visitor. Handsome and costly palaces were built; art and magnificence contributed to make the capital the first in the world. Every emperor tried to leave some monument. Sculptors, painters, stucco workers, mosaic workers, and architects flocked to Rome from all parts of the empire.

THE COLOSSEUM

The sixty-foot-height limitation fixed by Nero was soon disregarded, and Rome was the original "skyscraper" city. The population grew most rapidly, and a census report shows that there existed at the beginning of the fourth century 6 obelisks, 8 bridges, 11 great public baths, 856 private bathing establishments, 1352 fountains, 2 circuses, 2 amphitheaters, 3 theaters, 4 schools for gladiators, 36 marble arches, 37 gates, 254 public markets, 1700 private palaces, 3785 statues of emperors and generals, and about 6000 other statues, besides large and splendid public gardens.

Modern Rome remains a center of world-wide interest, and has much of its ancient grandeur. As the seat of the papacy it is to the Roman Catholics what Jerusalem is to the Jews. It is not only the city of the Vatican and St. Peter's, but also the capital of the modern Roman Empire, the kingdom of Italy. It combines the ruins of ancient and the splendors of modern civilization.

TOP. THE PANTHEON, TEMPLE TO ALL GODS, ERECTED BY AGRIPPA ABOUT 25 B.C. BOTTOM: FORUM OF TRAJAN

THE PANTHEON, PARIS — A FRENCH HALL OF HONOR

A classic structure, showing the monumental modern treatment of old Roman architectural forms. It is interesting to compare the portico and pediment with those of the Pantheon at Rome, shown on page 199, and the dome with the dome of St. Peter's, shown on page 211.

THE DOME

Among the public or semipublic buildings on the forum in a Roman city was the "basilica." Rome had several. They were usually of large size and lofty; of an oblong shape, with one end bowed out into a great bay or semicircular extension; and were divided lengthwise by two rows of pillars, the central space between which was three times as broad as the space between the pillars and the walls. These spacious and graceful buildings served the double purpose of courthouses and business exchanges. The court sat in the rounded extension at the end. The great hall, below the court, was the assembly place of the brokers, wholesale dealers, and auctioneers of the city, who in earlier centuries had done their bargaining out-of-doors in the forum or market place.

After the general adoption of Christianity under the rule of the popes, several of these basilicas in Rome and elsewhere were made into Christian churches; and when new churches were built in Italy or southern France, this general form was copied, so that these are known as "basilican" churches.

The dome was an architectural feature which the Romans carried to great perfection, as also did the Saracens in a smaller but no less useful way. These two influences were joined in the production in Constantinople of what is known as the "Byzantine" style, which has prevailed

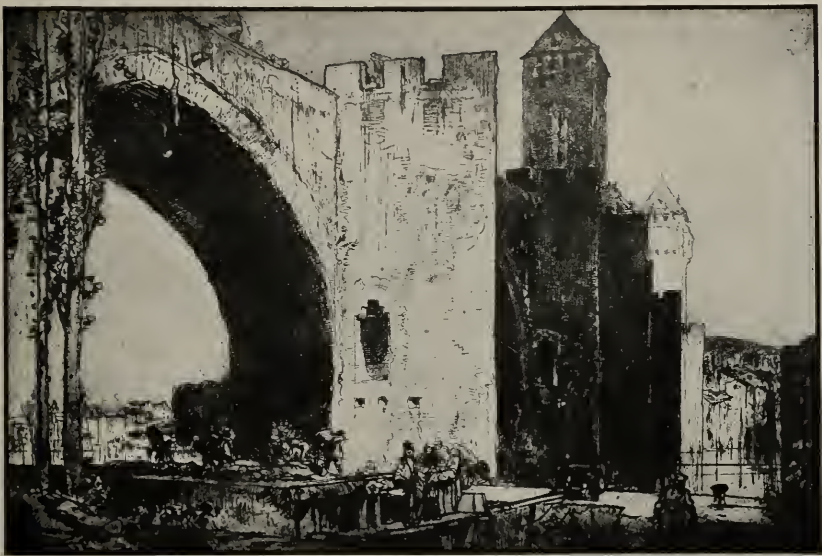
ST. MARK'S AT VENICE

An especially good example of Byzantine architecture.

A COURTYARD IN GRANADA

Showing the wonderful architecture which the Moors introduced into Spain, a style unequaled for delicacy and grace.

in the churches of the Greek faith; and from it has developed the peculiar style of the Russian Orthodox churches, especially fine examples of which are to be seen in Moscow. In the glorious Santa Sophia at Constantinople, the most famous of Byzantine churches, which was built by Justinian from 537, the great central cupola is surrounded by lower semidomes and domes of various sizes, "which heave up, one above another, like a cluster of bubbles." This church of Santa Sophia is declared by critics to be one of the great buildings of all time.



THE PONT VALENTRÉ, CAHORS, FRANCE

A splendid example of the early medieval fortification.

WHAT WE OWE TO THE ARABIANS

Among these early builders we must not overlook the Arabians, who, under the leadership of Mohammed (born 569 A. D.), conquered Persia, Syria, Africa, everywhere destroying churches and replacing them with mosques. The conquest of Syria gave them Jerusalem and the Holy Land, and there the rule of the Turk has lasted ever since, the Mosque of Omar replacing the Jewish Temple. In 638 Egypt was conquered and Alexandria was cleared of bishops, churches, and schools. To the Saracens we owe what is called the Moorish architecture, with its peculiarly graceful lines and its rich and elaborate details. When the Moors were in Spain they gave to that land its Alhambra. These frightfully destructive Arabs were also patrons of learning and science, which had been blighted by superstition and politics. To them we owe the preservation of much of the accumulated learning of previous centuries, besides much scientific discovery.

Brilliant examples of Saracen building are to be seen in Spain, where a very high civilization was developed by the Arabs. Under their administration Cordova boasted of more than two hundred thousand houses and over a million inhabitants. After sunset one might walk

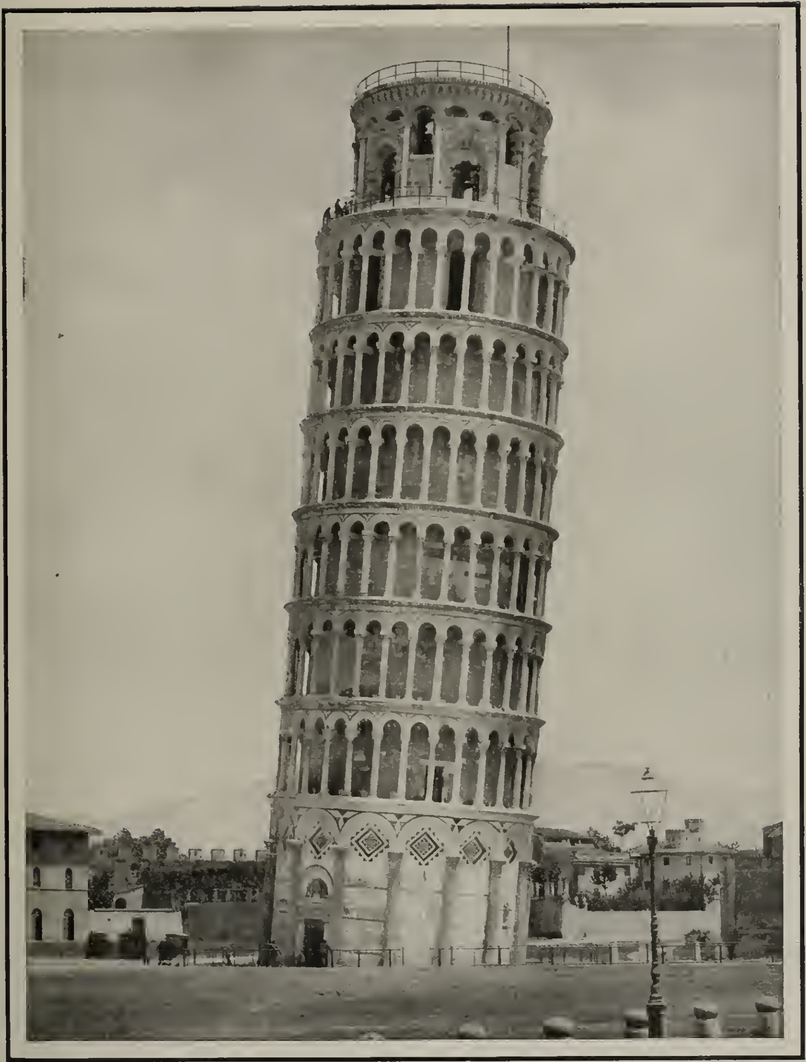
through it in a straight line for ten miles by the light of public lamps; while three hundred years after this time there was not so much as one public lamp in London. Its streets were paved, while in Paris, centuries later, whoever stepped over his threshold on a rainy day sank up to his ankles in mud. The palaces of the caliph were magnificently decorated. Cordovans might well look with contempt upon the dwellings of the rulers of Germany, France, and England, which were scarcely better than stables — chimneyless and windowless, with a hole in the roof for the smoke to escape, like some Indian wigwams. Lightness, grace, and elegance of ornamentation marked the Moorish buildings. The Giralda tower of the cathedral of Seville, imitated in the tower of Madison Square Garden in New York, and the Alhambra are of this rich and airy type.

GOTHIC ARCHITECTURE

Just how the style of building known as "Gothic" originated is not known, but the idea prevails generally that the graceful arches were suggested by avenues of stately elms. The Gothic style became the feature of the north of Europe, as the Romanesque and Moorish were of the south and east. In France, Germany, and England are found the most nearly perfect structures of this type, which culminate in lofty spires carrying the eye and thought upward.

Adopting the principle of the arch, the Gothic style of architecture proceeded to make the buttresses and supporting columns carry as much as possible of the weight of the roof — no slight burden in days when tile, slate, stone, and lead were the only reliable roofing materials.

PANORAMA OF THE PIAZZA DELLA DUOMO, PISA

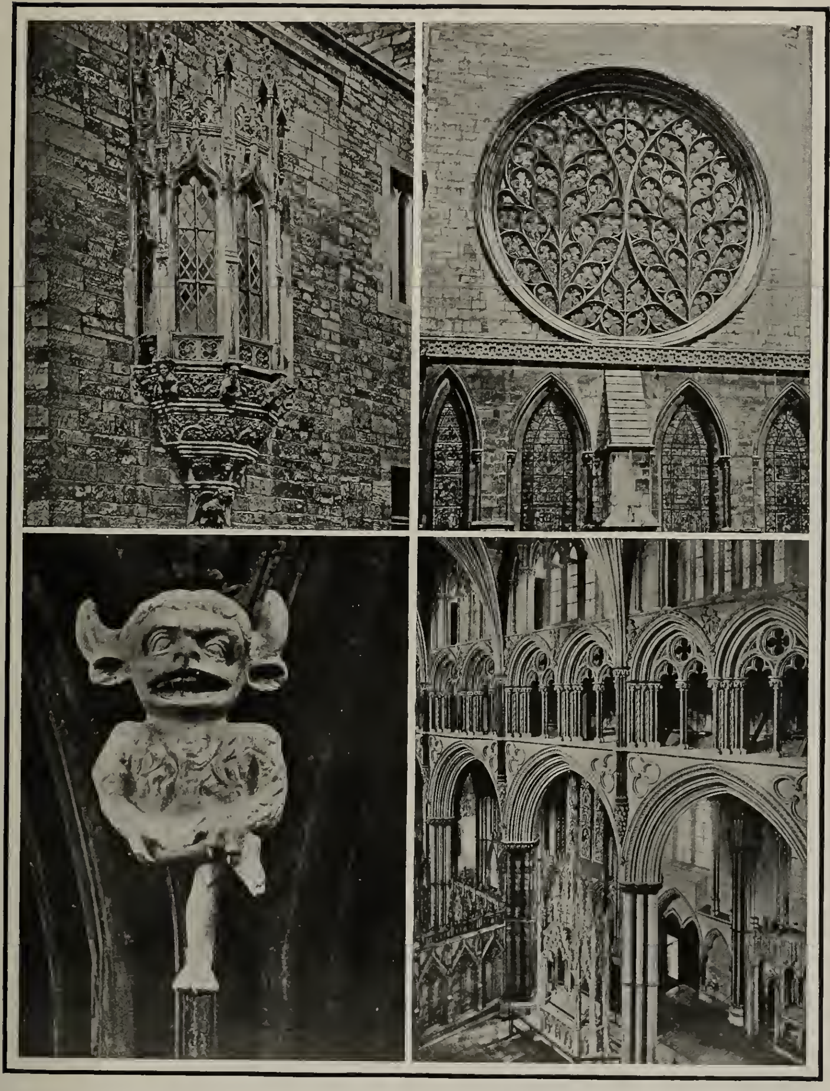


THE LEANING TOWER OF PISA

A structure of the Italian Tuscan or Lombard type of architecture that is similar to the Romanesque style in more northern countries. This bell tower, or campanile, is one of the curiosities of Italy because it stands so far out of plumb. While opinions differ, it is now generally conceded that the structure began to settle during its construction, the only theory which accounts for the obvious efforts made in the upper stories partly to correct this defect.

LINCOLN CATHEDRAL

The exterior of this typical English cathedral shows how much more precise and formal is the style of architecture than that of the French Gothic churches shown. In the interior view note the stone ribs and vaulting of the roof.



DETAIL OF LINCOLN CATHEDRAL

At the top are shown John of Gaunt's Window and the famous Rose Window. Note the beautiful leaf design of the latter. Below: The familiar Lincoln Imp, a grotesque characteristic of Gothic decoration; and the Angel Choir, so called from the figures of angels above the upper arches. This is considered one of the finest examples of English Gothic architecture at its best.

MILAN CATHEDRAL, A MODIFIED TYPE OF GOTHIC ARCHITECTURE

In this way there would be far more light afforded for the interior, which could therefore be larger, gaining impressiveness, as well as greater capacity, without loss of illumination. As it was found that the round arch employed by the Romans was not as strong for this purpose as a form which would throw more weight upon the supporting pillars, the pointed arch, which is commonly regarded as the characteristic feature of this style, was created. Another peculiarity was the use of the ribbed vaulting, in which the weight of the roof was carried by arches crossing and recrossing one another like beams in a timbered roof. In England, where the Normans had introduced the Roman type of construction, with heavy exterior walls to help the arches carry the weight, this truer form of the Gothic, in which the side walls served as mere protections and not as supports, is rare; and the walls assist the buttresses and pillars to a very marked extent, so that the window spaces are not so large, and in some cases are built directly above one another, instead of reaching from ground to roof. In the course of years, as builders sought variety, the simpler style of the early Gothic was more and more ornamented until a distinct type arose, known as the flamboyant or decorated, with beautiful, rich fretwork and tracery in the windows and in the interior carvings. This in turn was again simplified, so that in the closing period of Gothic art the perpendicular style, with a stern emphasis and restraint placed upon right angles and upright supports, was most

COLOGNE CATHEDRAL

Generally considered one of the finest and purest Gothic monuments in Europe.

prominent. Every part of Christendom is now adorned with churches conforming more or less artistically to this Gothic type, in which "the soaring architecture, the glory of stained glass, the might of the bells, the incense, music, and general effect of grandeur and solemnity all contribute to the feeling of spirituality and worship."

COLOGNE CATHEDRAL

Wondrously beautiful and imposing as are the cathedrals of England, yet, in general estimation, Europe provides the best-known and most famous Gothic cathedrals. In Italy, where the Gothic style can be said never to have become acclimated, the natives developed instead a form of Lombard architecture of which the façade of the cathedral at Pisa (see page 204) is an example. This style is a more delicate form of Romanesque, suitable to the finer materials in which it was executed. Among the modified Gothic buildings are, for instance, the duomo at Florence and the cathedral at Milan, whose intricate spires and elaborate details are much admired by travelers. Germany produced a better type of Gothic architecture than Italy, better because it was a style temperamentally more appropriate to the people. Probably the best-known German structure of this type is Cologne Cathedral, which took from 1248 to 1880 A. D. to complete. The cathedral seems too magnificent to be the work of any human genius. The legend is that one day, while seated on the bank of the Rhine, the despairing architect, who had been commissioned by the bishop of Cologne to build a cathedral that would surpass all others, was approached by the devil, who showed him a superb plan and asked for his soul in payment. The architect was unable to resist the temptation, and at midnight came to sign the pact. He, however, snatched the plan and, by means of a piece of the true Cross, vanquished Satan, who exclaimed in revenge, "Your name will never be known and your work will never be finished."

For centuries it seemed as if this prediction were likely to come true. The first part finished was the choir, which was consecrated in 1322. In 1447 the southern tower had mounted to the height of 180 feet; but during the Reformation work ceased altogether, and for centuries the splendid edifice was not even kept in proper repair. In the days of the French Revolution it was used as a barn. In the early days of the nineteenth century popular attention was directed to its unrivaled beauty, and subscription funds were started in order to complete it.

The cathedral is in the form of a Latin cross, and stands upon a height about sixty feet above the Rhine. Its spires can be seen fifteen miles away. The structure is 511 feet long and 231 feet broad, the length being equal to the height of the towers. So vast is the edifice that fifteen thousand people, gathered on an Easter Sunday, did not begin to fill it, and ten thousand more could have found place.

THE CHURCH OF ST. PETER

A return to more classic models culminated in the stupendous church of St. Peter in Rome. It is impossible here to give an adequate account of this great building, much less to describe its contents. It takes the place of a far older building, and was begun in 1506 from designs by Bramante; but construction proceeded haltingly until 1546, when Michael Angelo was commissioned by Pope Paul I to resume construction. He modified Bramante's plan and originated the unrivaled dome which is now the chief architectural feature and a wonder of construction. Professor Hamlin of Columbia University, in his "History of Architecture," pronounces it one of the greatest architectural conceptions in all history. "It measures," he tells us, "140 feet in internal diameter, and rises to a height of 405 feet to the top of the lantern. St. Peter's, as thus completed, is the largest church in existence, and in many respects is architecturally worthy of its preëminence. The central aisle, nearly six hundred feet long, with its stupendous paneled and gilded vault eighty-three feet in span, the vast central area and the majestic dome, belong to a conception unsurpassed in majestic simplicity and effectiveness."

A stranger who first gazes upon this structure, and tries to realize the magnitude of its interior as he walks bewildered among its treasures, can rarely find words to express his impression. Something of the same difficulty has affected

ST. PETER'S, ROME

Top: The Square of St. Peter's; the high altar. Bottom: The Vatican Library; the Sistine Chapel, showing Michael Angelo's painting of the Last Judgment.

even so experienced a writer as Marion Crawford, although from boyhood he had been familiar with the church and its traditions.

"The thing itself, the central cathedral of Christendom," he confesses, "is so far beyond any familiar proportions that the mind and judgment are dazed and staggered. The earth should not be able to bear such a weight without cracking and bending like an overloaded table. On each side the colonnades run curving out like giant arms, always open to receive the nations that go up there to worship. The dome broods over all, like a giant's head, motionless in meditation.

"The vastness of the structure takes hold of a man as he issues from the street by which he has come from Saint Angelo; . . . the picture is too big for convenient sight. The impression itself moves unwieldily in the cramped brain. A building almost five hundred feet high produces a monstrous effect upon the mind. Set down in words, a description of it conveys no clear conception; seen for the first time, the impression produced by it cannot be put into language. . . . It is hard to think the cathedral down to the little basilica built by Constantine, the sentimentalist, on the site of Nero's circus. . . .

WINDSOR CASTLE

At the time this was built the need for the fortress type of castle was dying out. Note the number and size of the windows, indicating the concessions made to comfort and convenience. The building is really more of a palace than a fortification. For the earlier style, see the illustration on page 203.

"The mere facts of real interest connected with the basilica, its foundation, its construction, and its subsequent history would fill a volume and overfill one man's brain. The church is not only a real landmark, . . . it is also, in a manner, one of time's great milestones, of which some trace will probably remain till the very end of the world's life. Its mere mass will insure to it the permanence of the Great Pyramid of Cheops. Its mere

name associates it forever with the existence of Christianity from the earliest time."

The most prominent and original architectural feature developed during the Renaissance period is the dome, which, beginning with the expression first seen in the duomo at Florence, arrived finally at the grand and impressive form best shown in the cathedral of St. Peter at Rome. Since the building of the Roman Pantheon, the use of the dome had never before been attempted in so lofty and grand a style.

THE CASTLES OF EUROPE

Having thus traced the progress of ecclesiastical architecture to its present historic conclusion, it becomes desirable briefly to perform the same service for domestic architecture, which only barely maintained its existence through the warlike medieval period. Under the feudal system, building was turned largely to defense. The word "castle" comes from the Latin *castellum*, a diminutive of *castrum*, a fort, and was applied by the Romans to their intrenched camps and frontier military stations. The cities of Greece, Sicily, Italy, and the older countries generally had always been walled, and usually contained an inner citadel or acropolis; but when the remoter districts were left to take care of themselves, the newer towns and cities were obliged to erect heavy walls; and even fortified dwelling houses, accommodating large garrisons of family retainers, were built. Europe became dotted with castles or fortresses of the feudal lords. Existence was a state of perpetual warfare. Every town was fortified, every important residence became a stronghold of its clan.

The Roman soldiers and the Gauls used to plan their cantonments in an oblong form, surrounded by a ditch and a wooden palisade, and raised in the center a lofty mound of earth, surmounted by a tower or blockhouse of timber, as a final defense. Such a citadel mound remains in Canterbury, England, to this day. Not much improvement was made on this primitive plan until the Norman invaders established themselves in northern France and in England at the close of the eleventh century.

Long before this the military engineers of the East had devised a more elaborate system of defense, to meet the increasing efficiency of weapons and assaulting engines. Many Norman barons and officers had been in Spain or the East and seen something of this, and they saw the value of making their donjons of stone instead of earth and timber. So during the twelfth century England and France were covered with stone towers, at first always square, with surrounding walls and moats, and these were the principal means of the subjugation of Britain by the Normans. The White Tower, which gives to the castle of London its popular name of the "Tower," is a striking example of this period. Although still kept as a fortress, the Tower has long been rather a state prison and an armory than a fort, and it is indissolubly connected with English history — especially in its darker pages.

THE GERMAN FORTRESSES

Feudal castles were built everywhere in the South German countries, and those in the mountainous districts of the Tyrol, Württemberg, and Bavaria and along the course of the Rhine and its principal tributaries were often of extraordinary picturesqueness as well as strength. Their sites were in many cases the summit of some almost inaccessible rock, to which they clung on the very edge of precipices, and whose natural summit they continued in a cluster of steep-roofed gables and bristling towers. For some of these "eagle nests" scarcely more defense was necessary than a high stout wall and trench across the narrow neck by which alone the house could be reached. "They were small piratical aeries. . . . Still, the elaborate network of these forts, their grouping to protect the whole Rhine valley, its cities and towns, make them interesting as a social and political if not as an engineering study." They would have remained in their original condition to this day, no doubt, had it not been for the destructive work of the Thirty Years' War, and still more for the wanton wrecking indulged in by the armies of Napoleon, which laid waste the whole of the Palatinate. A few, it is true, have been "restored," and are occupied as residences in summer; and one, Ehrenbreitstein, has almost entirely disappeared under the walls of a modern fortress.

MODERN ADAPTATIONS OF DORIC, IONIC, AND CORINTHIAN COLUMNS

Top: Recessed porch with Doric columns; portico with Ionic columns. Bottom: King's Chapel, Boston, showing the Colonial use of Corinthian columns.

A COLONIAL HOUSE ON THE PACIFIC COAST

OUR DOMESTIC ARCHITECTURE

It is interesting to trace certain of our own house styles back to their origin on the Continent. The Renaissance in Italy developed a modified form of classical architecture of which the Italian palaces are beautiful examples. In England it became in turn the Georgian architecture, so called because it was introduced during the reigns of the Georges. There, features suitable to marble and stucco were modified by the use of the limestone and brick of England. It is directly from this Georgian house that we have inherited in America our

THE SOUTHERN COLONIAL ARCHITECTURE, AS SHOWN IN THE LEE MANSION

TOP: CITY HALL, BREMEN, GERMANY, SHOWING A TYPE OF ARCHITECTURE WHICH IS WHOLLY TEUTONIC.
BOTTOM: A CALIFORNIA HOUSE WHICH IS A MODIFIED EXAMPLE OF THE TEUTONIC TYPE

TOP: RAILROAD STATION IN NEW MEXICO, WHICH IS PURE SPANISH IN ITS ARCHITECTURE.
BOTTOM: A CALIFORNIA BUNGALOW

Copyright, Harris & Ewing

THE UNION STATION AT WASHINGTON

The Greek type is very easily recognized. Compare the pictures of the Acropolis and the Theseum (Vol. VIII, pages 311 and 314). The arch, however, shows the Roman modification of the Greek principles.

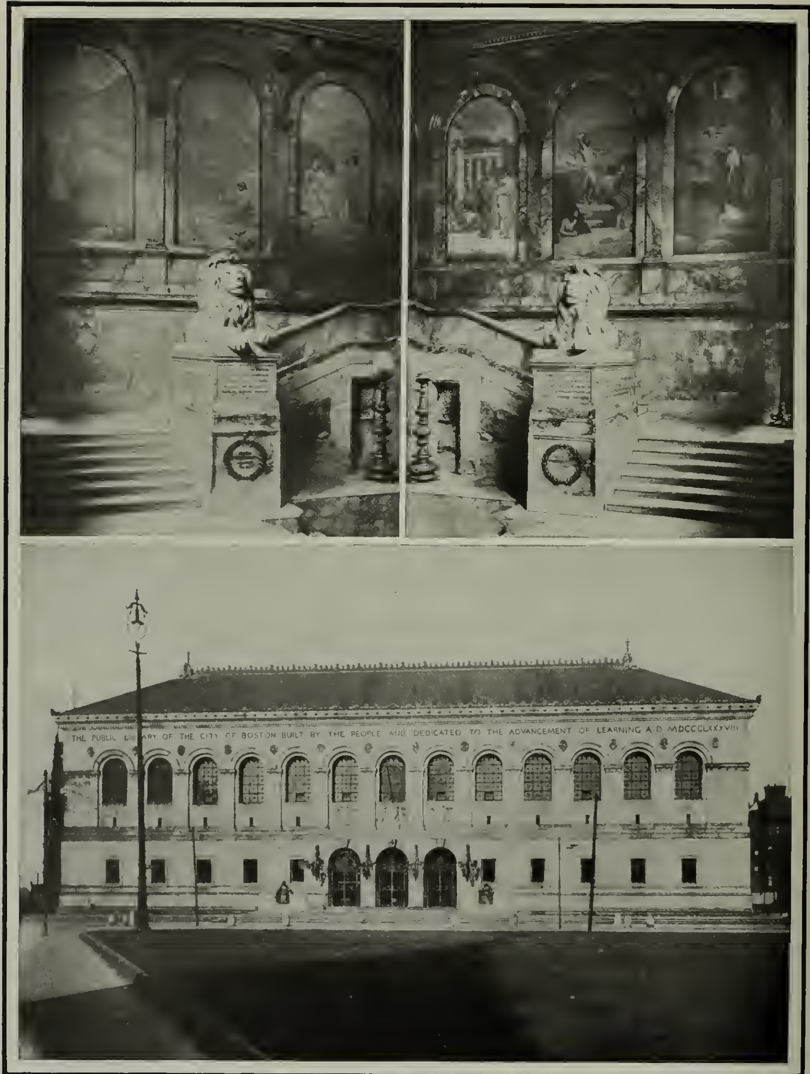
Colonial style; but as wood was more available and much cheaper in the colonies, the stone columns were made lighter and thinner to fit this new material, and moldings for cornices or window frames were correspondingly lightened in order not to conflict with the wooden wall upon which they were to be placed.

During the nineteenth century no new architectural style developed, because the energy of the people during that century was given to using over again the historic styles of their own and other countries. There was a period early in the nineteenth century when Greek architecture was employed for houses, churches, and monumental buildings alike. Many houses of this type still exist in the eastern portions of the United States. After this fashion passed there came a period when stone Gothic details were imitated on wooden houses, as well as on churches and other public buildings; and it was only at very near the end of that century that America and England began to strive to reproduce the best of their native Georgian and Colonial architecture, which they thus tardily began to realize formed the best precedents for domestic and public work appropriate to both countries.

While English Georgian and American Colonial houses furnish precedents for our best modern American dwellings, the classical architecture on our public buildings has come to us touched with a new flavor, obtained from its modern standardization in the French École des Beaux-Arts, where architecture has been studied "in the grand manner" necessary and appropriate in its application to public work in modern cities.

Modern architecture, when all is said and done, has but little more than borrowed the methods and styles of preceding periods. However, in the opportunities afforded by new structural materials, most notably the steel girder and span, we have been able in the skyscraper to produce a new variation. Although we utilize at will — and often with little regard for consistency or appropriateness — Classic, Gothic, and Renaissance styles, yet the newly possible great increase in height has made a decisive change in proportions; our decorative methods are having to be revised accordingly, and we are feeling our way to a truly divergent type of architecture. Our best English and American work has, nevertheless, still been based upon the achievements of past ages, as in the Gothic forms of the Woolworth building and the Italian beauty of the Boston Public Library.

A MODERN ADAPTATION OF GREEK ARCHITECTURE, AT NIAGARA



Copyright, Boston Photo News Co.

THE BOSTON PUBLIC LIBRARY

Above: Views of the Grand Staircase, showing the distinguished mural decorations by Puvis de Chavannes. Below: The exterior of the library. This building is ranked among the finest public edifices in the New World.

Copyright, Underwood & Underwood

THE WOOLWORTH BUILDING, NEW YORK, FROM CITY HALL PARK

Notice the long vertical shafts, suggesting the construction, characteristic of the Gothic, and also the Gothic decorative features of the upper portions of the main building and of the tower. This gives the structure a churchlike effect.

PANORAMA OF LOWER MANHATTAN, SHOWING

This is the view that greets voyagers from Europe as they come up the harbor from the Lower Bay. The large ocean steamers dock in the North River, at the left. In the far distance looms the Metropolitan Tower; directly in the middle is the Woolworth Building, and to the right of the latter the tower of the Singer Building.

THE SKYSCRAPERS

THE achievements of men throughout the history of the world have been conquests of difficulties — success in an effort to do something that needed to be done, or to supply some new want for which Nature had made no provision. The very modern system of the construction of steel-framed, wall-supporting buildings, which has given us the skyscraper and the vast spreading roofs of great halls and auditoriums, is a solving of the equally modern problem of how to enable a large number of persons to do business within a limited space.

It would seem as if this were an instance of most complete originality — something toward which all the engineering and architectural experience of the world had lent little help, even in the matter of foundations. As for direct lines of descent or suggestion, this is true; but observe how, indirectly, the means and conditions which rendered this kind of construction possible, when a need for it arose, had been gradually forming and accumulating. The art of making cheap steel in great quantities, and rapidly, which resulted from the discovery of the Bessemer process; the ability of perfected railroads and hoisting machinery to assemble it and other

SKYSCRAPERS AND THE EAST RIVER BRIDGES

Copyright, Detroit Publishing Co.

At the right is the East River, which connects New York Harbor with Long Island Sound. At the extreme right is Brooklyn. The first bridge to be seen is the original Suspension Bridge; next is the Manhattan Bridge, and a mile farther up the river can be seen the Williamsburgh Bridge.

materials rapidly and to handle it deftly; the production of hydraulic cement in vast quantities at a reasonable price; the invention of the elevator; the contrivance of the many mechanical and electrical devices without which a lofty office building would hardly be usable — all these materials and appliances had to be produced by slow growth before the "originality" of the steel-frame building could be made practicable, even if conceived.

But it was not conceived until the need arose, and then but haltingly. What was the need?

The introduction of steam as a motive power in transportation, the invention of the telegraph, and the extension of mail facilities had had the effect of building up great centers of population — cities — at favorable points, and of concentrating there trade and manufactures. The disadvantages of distance between the producer of raw material and the manufacturer or distributor of it had nearly disappeared; and as a consequence the makers and the sellers and buyers of things, and the men who were interested in the financing of enterprises, wished to get themselves and their operations close together. So cities, and especially the principal seaports and railroad centers — the strategic points of business — grew until they were

densely crowded, and land became extraordinarily valuable. In certain parts of New York and Chicago, for instance, an acre would perhaps now cost ten million dollars.

Land of that value could not be made to pay even the taxes, because the necessary rental, shared among so few tenants as the old-fashioned buildings, only five or six stories high, would hold, would be prohibitive. At the same time there was an ever increasing desire by men of affairs to crowd into certain limited districts. The problem was to satisfy both demands — to get more rent-paying tenants upon each square yard of ground, and to enable more persons to gather at desirable centers of affairs.

It was useless to talk of towers of brick or stone, for, in the first place, business men and women could not and would not climb long stairways; and, in the second place, to erect them of adequate height would require such thickness of walls near the base that little space would be left for rooms there — not to speak of the expense of construction. But by erecting a framework of steel posts, girders, and braces in place of walls, and then filling in their spaces with tiles, bricks, or stone, or forming the masonry into a veneer on the outside, the wall surrounding each story borne by itself on jutting extensions of the floor beams, the walls of a very tall building may be kept of almost uniform thickness throughout. Do this and the problem is solved.

A transitional stage between the old-time masonry construction and the modern "skeleton" building was the "cage" method, an example of which is the Produce Exchange in New York, in which the walls are built of masonry and are self-supporting, but the interior weight is carried by steel frames, thus saving the pressure on the outer walls. This type, however, was quickly superseded by the present form, in which the steel frame also carries its inclosing walls.

One paramount advantage of this style of construction is the fact that the space about the building does not have to be encumbered by a great amount of materials, slowly shaped and combined. In effect a modern skyscraper is manufactured in steel mills, brickyards, cement factories, and other shops and quarries in various places, transported piece by piece to the building site, and only put together there, each piece fitted into the exact place designed for it.

The erection of a modern steel building, then, is a much more formidable task than it appears to the stranger who marvels at the celerity and ease with which it rises. The speed he sees is a matter of the utmost importance, and begins the moment the structure is decided upon. Men are at once rushed to the site to prepare for the foundations, while the architect hurries forward his designs and calculations and sets in motion the preparation and assembly of materials. There is a host of problems to be met, and artists, builders, contractors, manufacturers, financiers, and renting agents instantly attack them, for the saving of time is the foremost condition of success, considering the affair as an investment.

The first thing needful is completion of the plans. In the office of the architect a great staff of assistants begins figuring on the general form of the building, the weight the floors will support, the shape, size, substance, and amount of each kind of all the various materials needed. Long before the plans are fully worked out, however, the contractor can begin to order the stuff from timber yards, steel mills, brickyards, quarries, etc., many of them hundreds of miles away. Some of the calculations enabling him to do this are such as a person would not at once think of. The architect must not only know the total weight of his proposed building, with all its probable contents, including some hundreds of tenants and their visitors, in order to determine the needed strength of foundations and main supports, but he must also determine exactly how much strain each girder, each column, even each rivet will bear. "If he overloads any single girder, he endangers his whole building. Then he must calculate how much wind is going to blow against his building, and from what direction most of it is coming. He must even calculate on the pounding of horses' hoofs and heavy wagons on the pavement outside; he must make provisions for supplying water to the top stories, where the city cannot pump it; he must provide amply against possible fires — and that is one of the most difficult of all the problems; he must see to the prevention of rust in his steel work; he must secure proper ventilation and lighting . . .

Copyright, Boston Photo News Co.

STRUCTURAL STEELWORK ON A SKYSCRAPER

Fitting the girders and testing the rivet holes. Guiding a girder into place.

and he must keep well within the limits of the city's building laws. These are only a few of thousands of intricate details, not to consider the tremendous question of cost, with which the builder must grapple."

As soon as the site has been cleared (and perhaps this involves pulling down a big building, or even a block of buildings), the space is quickly filled with machinery such as would not have been dreamed of by builders a few years ago — derricks, drills, chutes, pile drivers, hoists, odd-looking concerns for mixing cement, and noisy engines for their operation; and often the work goes on all night under the glare of electric lights.

Knowing how far the building is going up, the architect must determine from its weight and the character of the site how far it must go down, and this may extend in some cases to seventy-five or even one hundred feet, so that there will be several stories beneath the level of the street. In New York most of the great buildings rest upon the solid rock, but in Chicago all are borne upon a forest of piles, or else upon platforms composed of layers of steel beams and cement formed into a solid slab of great thickness. Some settlement (a fraction of an inch) is expected, and the effort is to make this settlement uniform. Some buildings have arrangements at the bases of their columns by which they can be lifted by hydraulic jacks, and a steel packing inserted beneath them, should they settle too far or tip a little.

The work of setting up these skyscrapers goes on so swiftly and smoothly that the onlooker does not realize the fine organization which makes it possible. They are almost always situated on crowded streets, which cannot be blocked even for a few hours. Therefore the thousands of girders, the tons of bricks, stone,

Copyright, Underwood & Underwood

TWENTY-FIVE STORIES ABOVE THE STREET

Among the wonders of skyscraper construction are the daring, strength, and skill of the men who put the framework together.

and lumber, must be delivered only as needed, a day or two's supply at a time.

"Everything must move like clockwork," as Francis A. Collins has told us in *St. Nicholas*. "The directions for the work on such a building read like a time-table. If, for instance, the cement for the foundation should be but a few hours late in arriving, the entire force might have to stand idle. . . . Every part depends upon something in one or more departments. And since as many as fifteen hundred men are employed on one of these steel structures at the same time, the loss of a day would cost thousands of dollars. As a matter of fact, under favorable circumstances, one of the buildings rises at the rate of about four stories a week. The finishing of them will of course take much longer."

One novel and surprising feature of this new sort of house building is the fact that it is no longer necessary to begin at the bottom to build up the walls. As each story carries its own case on projections from its frame, this casing may be applied anywhere as soon as the frame is ready. Hence it is not at all unusual to see the sixth or tenth or thirtieth story walled by a belt of masonry before even the basement has been closed to the weather.

The endurance of these steel buildings is still somewhat a matter of doubt, although it is believed that the later ones, at least, may count upon a very long life. "Most skyscrapers are only a few years old; but examinations of steel columns erected ten years ago and housed in cement, and of foundation beams lying below the water line, have shown that not even the blue-black scale from the rolling-mill finish has turned color. Wherever it is possible, these steels are buried in cement, in itself a rust-proofing, and under such conditions the steel-constructed building promises to stand as long as it is wanted."

PROTECTION FROM FIRE

It must be remembered, however, that steel is easily affected by fire; and the modern skyscraper, being so much above the level to which the protection afforded by the municipality extends, is particularly liable to injury from this destructive element. Accordingly every piece of metal must be protected by some easily applied nonconductor of heat. The building laws of most cities are particularly stringent in this regard, because if one column of iron is heated enough to twist, deflect, or melt, it fails in carrying its proportionate part of the building's weight, introducing new stresses upon other steel-bearing members of the framework that they were not intended to resist. From their failure the destruction of the entire edifice may be brought about. Terra cotta, a burnt-clay product filled with voids and air spaces, because of its light weight and permanently insulating qualities is the protective agent most generally used for fireproofing ironwork.

Of late years much discredit has come upon the term "fireproof," because of the carelessness with which it has been used by architects, builders, press, and public; being applied, without reason or authority, to buildings of all classes of construction. The earlier office buildings, of four to six stories, were often of "slow-burning" construction — meaning that heavy timbers, extending from brick walls to heavy wooden posts or brick piers, were floored with thick planking. This form of construction is still used for factories a few stories in height, because of its comparative lack of expense and the ability of the heavy timbers to resist small or local fires longer than iron, which heats more quickly to a point where it will fail to maintain the load it is intended to carry. The gradual increase in the cost of wood, and the difficulty of getting timbers of large size, have within a few years caused this kind of construction to be supplanted by concrete, which, reënforced by iron rods and braces, is a stronger, more durable, and often less expensive method of factory construction.

THE USE OF CONCRETE

One of the most important influences that has been exerted on building has been the gradual simplifying and cheapening of the process of manufacturing cement, as it has enabled concrete to be structurally used with a freedom and cheapness never before possible. This "discovery" seems again to duplicate an old process, as a similar material has been found used in a nearly similar way in excava-

tions made in the Forum, and other sites where Roman engineering works have been preserved. It was there generally employed only as the core of wall construction, however; it needed the introduction of iron to make the material capable of supporting long floor spans. In America this construction is called "reënforced concrete"; abroad it is generally known as "ferro-concrete."

Concrete is rendered much more available for modern use by the introduction of a meshwork of thin rods forming an iron reënforcement, which serves greatly to strengthen the material, enabling it to be used in thinner sections to carry a great deal more weight. The whole idea of employing concrete is interesting, because it is based on an artificial application of a natural product. The cement is, in the first place, made from limestone in such a way that it becomes its pulverized essence, in which state it can be transported to remote locations for a small freight cost. There, by recombining it with water and diluting it with larger binding ingredients — such as are provided in gravel, cinders, or sand — it is remade into something approximating its first natural stone state; while the forms and outlines into which it sets are artificially controlled and directed by the ingenuity of man, who has thus once more made use of the processes of Nature to serve his own small purposes.

Concrete is also easily available for some portions of large office buildings, which are now so consistently being built of "fire-resisting" materials that they can truthfully be termed "indestructible." This requires that doors, window frames, and sashes must be of metal; floors, of tile or concrete surface; all glass be "wired," and that even the office furniture be "unburnable!"

A FIREPROOF HOUSE OF CONCRETE, BUILT IN ARTISTIC STYLE

FIREPROOF HOUSES

The rising cost of wood is even helping to change building conditions in regard to dwellings; and there is, too, coming to be recognized a strong tendency toward the permanent fireproof dwelling. This particularly applies to houses in country districts remote from fire appliances, and also to houses intended for an exterior plaster or stucco treatment. The permanent outer wall of terra cotta already costs no more in many localities than a wooden-framed building. This tendency toward the

Copyright, Boston Photo News Co.

CONCRETE CONSTRUCTION

Above: Chapel at Roslindale, Mass. Below: Courtyard of a seaside home, Marion, Mass., in which there is a strong Spanish feeling.

more permanent house is also responsible for a simplified and condensed house plan, arranged in such a way as to save steps in housekeeping and make convenience in location of rooms and access between them more important than ever before.

The use of concrete for floor construction, in connection with terra-cotta tile spans, is also of assistance in producing buildings of clean, sanitary arrangement and eliminating all corners and finish calculated to catch dust and dirt. Doors of refined plainness and beauty of natural wood finish are coming to be preferred to doors with intricate panels and moldings. Walls painted with sanitary paint and finished, without gloss, in some neutral color, are being given preference over wall papers, with their tendency to absorb moisture, germs, and dust. Simplified plumbing and heating systems, eliminating opportunities for the collection of foul air, germs, and rust, with an accompanying actual saving in expenditure, are slowly but steadily growing in modern favor. All these factors are causing changes in modern dwellings as noticeable as the accompanying change in house furnishing and decoration from Colonial and mahogany furniture to the earlier English styles of furnishing and to walnut and oak woods. As the skyscraper has come to express the most extreme density of population in the city, so the house of economy and convenience in arrangement and tastefulness in furnishing and fitting has spread through the sections of country surrounding our centers of population, each produced by those same inventions and conveniences that have made the other possible.

In both directions increasing emphasis is being placed upon a combination of the simplest utilitarian qualities and taste, although progress in the latter particular is slow and seems sometimes to follow a devious course. But most notable of all, and as apparent in the skyscraper as in the dwelling, has been a seldom recognized realization of the importance of conservation of human health, as well as of energy and life. As a result of these distinctly modern tendencies, even our crowded cities are slowly replacing old and long-outgrown rookeries with new, sanitary, more healthful dwellings.

CITY PLANNING

IT is, indeed, the recognition of this new and important factor that is responsible for the spread of "city planning" and the increasing attention given to it by the employer, the public, and the press. As in most movements of this sort, America has lagged far behind the older and more advanced civilizations of Europe. In Germany, for instance, the government, recognizing the necessity of insuring in the future strong and healthy material for its omnivorous war machine, has placed especial emphasis upon the arts of city planning and housing, in both the city and the suburb. In England it is the manufacturer who has generally recognized the importance of the human element in his business and made similar attempts to provide his workingmen with a system of comfortable, healthful housing.

City planning is not to be misunderstood. It is not merely a matter of esthetics, of civic centers, or even of parks. These are, it is true, the more spectacular elements, the things that appeal most to the eye or the imagination of the reader or spectator; but they are all subservient to the more important fundamental need of providing healthful, practical, and convenient living conditions for all members of the community.

THE ROMAN CAMP — AN EARLY EXAMPLE

Rome was probably the first government farsighted enough intentionally to plan for the health of its population. The Roman lesson was learned and practiced first in the camps of its armies, where the lives of the soldiers, particularly when at distances remote from their headquarters, were of great and easily recognized value to the empire. These Roman camps were laid out therefore with an eye to health, to convenience, and to handling the soldiers and moving them easily back and forth, in order the better to repel attack in case the necessity arose. There were generally two principal intersecting streets extending through the camp and continuing outside the walls. At the center, where the streets crossed, was a small square, with the principal general offices, while the regiments were conveniently distributed over the inclosed area. Particular attention

was given to health and sanitation in these encampments; and the lessons that there became natural to the soldier must have gone far to provide for the health of those communities to which they afterward went to live. Aided by this experience, the various Roman emperors, when rebuilding portions of their capital, or establishing new cities in conquered countries, imposed similar rules for the arrangement, guidance of traffic, sanitation, etc., of these new communities. During the Middle Ages these principles were long disregarded and forgotten, but they were again slowly rediscovered during later periods, until we are to-day once more coming to realize the importance of the very selfsame fundamental principles — egotistically considering them to be discoveries new to our own age.

WHAT IS ITS PURPOSE?

Seen in this light, the practical need and the advantages of the science — as well as the art — of city planning should be obvious to every individual. There are also other economic advantages which are more slowly appreciated under the wasteful methods of government still common to our democracy.

Properly speaking, city planning covers the correlation and economic simplification of all those elements obtained in modern community life. It refers first to the arrangement of streets, the principal large traffic highways and avenues radiating from the city center; a proper and convenient system of circumferential streets, providing direct communication between suburbs; smaller, less important streets, conveniently arranged for traffic, for business, and for dwelling purposes; a proper relation of all these streets to centers in the community, to each other, and to those constantly varying natural elements found in every town site; a care, also, of waterways and possible harbor development, with the restrictions imposed by bridges and their approaches; the relation of streets to different elevation heights and grades of the area where the city is located — in all of which proper provision must be made for the health of the community by providing breathing spaces in business as well as residential districts, in which economic and appropriate use must be made of existing forested sections, of watercourses and natural park centers — as well as of the connecting park avenues necessary to link the system together and relate section to section for convenience and utility in use.

It provides for the appropriate location of available markets, gymnasiums, public baths, recreation centers, churches, schools, college and administrative sites, including the municipal center; the proper entrance and course of railway lines tying the community to other communities in the same way that it relates its suburbs to each other and to itself; with the proper locations for stations for both passenger and freight purposes. Of great importance are the interurban systems of transportation subways, with stations located in close relation to surface lines; the arrangement of sufficiently large sewage, water, gas, and electric systems, with their necessary centers of distribution and repair; the proper construction, maintenance, and care of streets; the economic relation of public departments; the financing and valuation of public utilities and improvements; safe and rapid means of communication; rational housing; and the healthful distribution of inhabitants.

There are further to be included the selection and prelocation of districts appropriate and available for certain business interests, for factories and their accompanying dwelling sites; the regulation of building for considerations of safety, permanency, and health; provision for the necessary residential suburbs and workingmen's colonies; the near relation of the communal industries — the many complicated problems of planning a new, or replanning an old, city (in which, after all, we in this country have generally to deal with conditions less complicated and less firmly established as to custom than is the case abroad), as well as the possibilities for economy evidenced by the use of the proper foresight and experience in this sort of work.

This short summary will serve to suggest briefly the final importance to every individual in the community of the principles of town design, or city planning. For the recently popular slogan of "Safety first," the advocate of town and city planning substitutes "Health, safety, economy, and convenience; first, last, and all the time!" as the latest, most advanced, and most important principle in the building world.

Courtesy of Massachusetts Highway Commission

BEFORE AND AFTER IMPROVEMENT

These two views show the same road, in the upper picture almost impassable from mud, in the lower transformed into a modern highway.

Copyright, Boston Photo News Co.

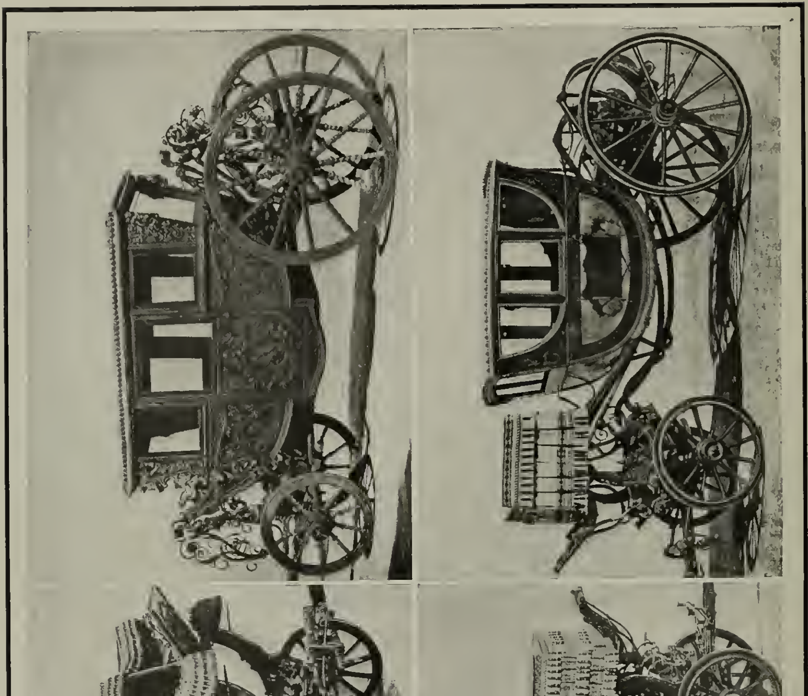
A ZIGZAG MOUNTAIN ROAD IN THE TYROL

ROADS AND ROAD MAKING

FROM FOOTPATH TO HIGHWAY

IN all our present-day civilization there is nothing that has had a greater share in bringing the peoples and the products of the world together than the highway. Commerce is developed, travel promoted, languages are interchanged, and remote races made kin by that ribbon of dust — the broad highway. There is no more striking picture of national desolation than the fifteen words in Judges, "In the days of Jael, the highways were unoccupied, and the travelers walked through byways." No safety, no free, open interchange between towns and villages, no trade; only unoccupied highways, and travelers making their way through the byways.

The ancients were great road builders. From early Babylon three highways extended. When, in 312 B.C., Appius Claudius began the construction of the Appian Way leading from Rome down through central Italy, it was because he recognized that this thoroughfare would link Rome more closely to the cities through which it passed. Over a level road soldiers could be sent more quickly to quell uprisings, and the runners, who were in those days the message bearers, could bring tidings with far greater speed. Therefore the wise emperor began the work of road making, and other leaders who followed him carried it on. Throughout Italy, and in parts of France, Austria-Hungary, Germany, and England, these roads built by the Romans so many centuries ago are still to be found. Most of the chief highways of England were



Copyright, Boston Photo News Co.

ROYAL EQUIPAGES OF THE DAYS OF THE COACH ROAD

first laid out by the Romans, who are said to have constructed over twenty-five hundred miles of such roads in southern Britain.

THE PERILS AND DIFFICULTIES OF EARLY TRAVEL

Of course, one must not for a moment think that because there were roads in the early days there was any complete system of highways reaching over the country as there is now. If a traveler wished to journey off the beaten track, he must ride across country, taking as landmarks the castles, mountains, or streams whose location he knew. The wooded land and desolate stretches between the castles and their outlying hamlets was infested with lawless bands of robbers who imperiled the lives of those who rode abroad. Men traveled in armor, accompanied by many followers, all heavily armed.

THE COACH ROAD

With the beginning of travel by coach the roads slowly improved, although it was a long time before people ventured far beyond the city limits after nightfall. Even in the daytime traveling was slow and difficult work, offering great opportunities to robbers, who waylaid the coaches, with little likelihood of meeting with stout resistance or of being captured afterward. Highway robbery became a common incident.

COUNTRY TRAVEL BEFORE THE DAYS OF RAILROADS

After a time taverns were built at convenient distances for the refreshment of travelers as well as the change of horses, and a very strong, fleet kind of horse was bred to meet the demand for this traffic; to this day the "English hackney" has no superior for use with wheeled vehicles. One of the most famous coaching routes was that leading from London to Oxford, and there were scores of others radiating from the city like spokes from the hub of a wheel. Who of us has forgotten how Mr. Harry Foker, Arthur Pendennis's friend, tooled down from Oxbridge to Baymouth; or how the good Major arrived at Fairoaks after twenty-five hours in a tight mail coach with a hard seat, a frequent twanging of the horn at the turnpike gates, and a perpetual change of coachmen who grumbled because the passengers did not fee them enough?

AMERICAN ROADS

The building of roads in the United States has been carried on under four distinct agencies. There have been the national roads, among which some of our most famous highways of former centuries are numbered; state roads, which are becoming more common; county and town roads; and private roads, built by individuals or groups. To render every part of the United States reasonably accessible by roads would require over twelve million miles of highways, or an investment in roads of something like ten billion dollars. And this would still leave unaccounted for the mileage of village and city streets and the roads leading to very small farms.

Even in our oldest settled states there remain many interior sections untouched by regular roads. In the great Western states are districts as large as the whole of any one of the New England states through which no highway passes. And yet millions of miles of roads have already been built.

NATIONAL ROADS

Only a small part of the expense of road making has been borne by the national government. Before the day of railroads, when Western emigration was beginning to assume large proportions, the United States government built a great road more than fifteen hundred miles long. It began at Baltimore, passed through Pennsylvania and down the Ohio valley to Cincinnati, from there to Indianapolis, and thence across the prairies to Council Bluffs. This road was built of broken stone on the macadam principle, and is still maintained, though the charge is borne by the towns and counties through which it passes.

After the introduction of railroads, little or nothing was done by the national government in the line of road building, but a strongly supported movement is now on foot for the construction of a system of national highways. The growth of travel by automobile has created a demand for better through roads than come from the accidental connection of town highways. It is also believed that the construction of such roads would greatly hasten the development of farm lands.

STATE ROADS

Almost all of the states of the Union are now doing something in the way of road making. Massachusetts roads are acknowledged to be among the best in the world. The plan upon which they are built is that of forming an elastic, in place of an unyielding, surface. Care is taken to have the roads well graded to a slightly curved surface and well drained. The covering used is broken stone mixed, in the top course, with some of the many tar and petroleum products. Such roads become very smooth, elastic, dustless, and waterproof. They wear remarkably well and are easily repaired. New York State has appropriated the largest sum of money of any of the states for road work. The grand total of fifty million dollars has been set aside to be spent in a series of years in the construction of a great system of state highways.

A very remarkable example of the interest now being taken by states in road building was the setting aside of a day by the state of Kansas in which the citizens were asked to give their services in labor to the state for the improvement of roads. Hundreds of thousands of citizens of all classes responded, and the amount of work done in that single day was enormous.

The next ten years will see hundreds of thousands of miles of roads built and improved by the various states of the United States.

COUNTY ROADS

Outside of the New England states, the majority of the roads are built and cared for by the counties. It is the unsystematic character of these county roads that has given rise to the demand for state and national roads. As a rule the county merely takes over and improves some section of farm road that has come to be used as an important thoroughfare. Such roads are usually winding and haphazard in their courses. Some follow old wood roads used for getting timber out of the forests. Others are more natural routes of travel and follow the courses of old Indian trails. Many fine highways that now pass between farms and villages were once narrow and indistinct trails through the forests, traveled for centuries by Indian war and hunting parties. In many counties work on the roads is done principally by prisoners, called "chain gangs," who may often be seen breaking stone or grading and repairing roadways, especially in the Southern states.

TOWN AND TOLL ROADS

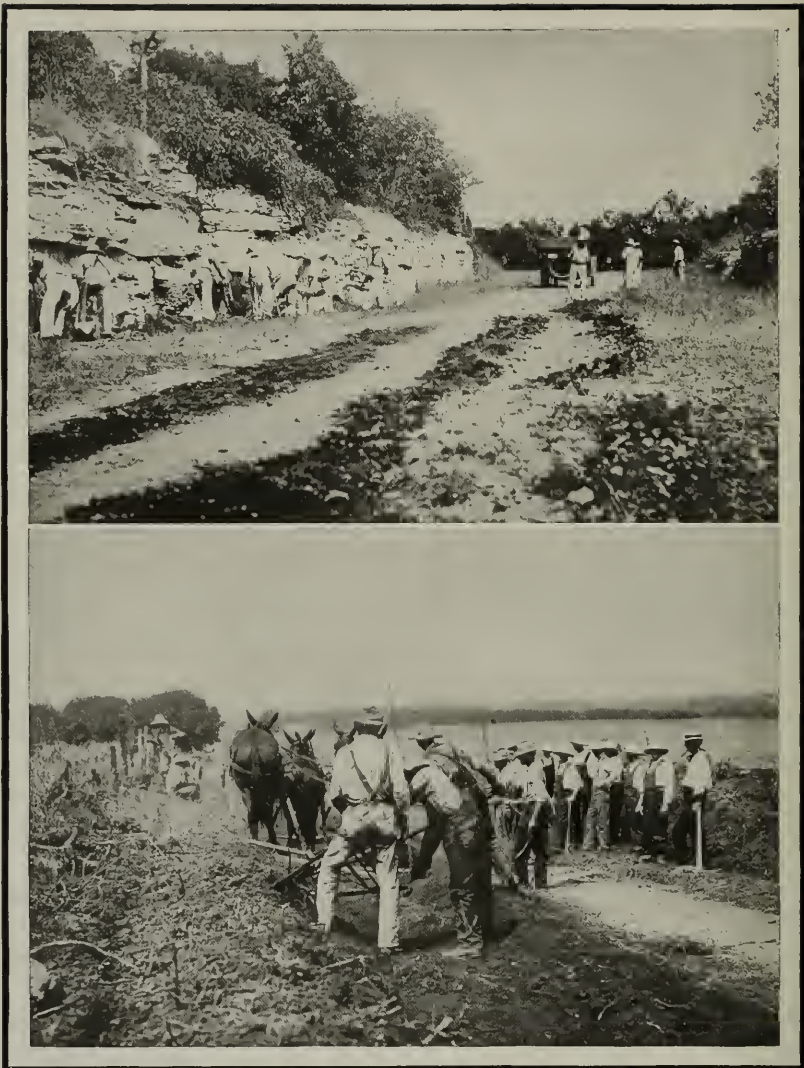
In New England the town assumes most of the functions that belong in other sections to the county. Among these are road building. As the town is a smaller territory than a county, the result of town management is to produce even greater irregularity and unsystematic connection of roads. It has long been a custom in New England for the town to allow all who wished to work out their road tax. The result has been the often useless employment of unskilled and irresponsible labor for very short periods. Little is done on these town roads but to throw some road metal on the bad places, maintain bridges over streams, and keep the underbrush back. This was thought quite sufficient by the farm population up to within ten or fifteen years.

In order to stimulate the building of roads in early days, when few were willing to endure heavy taxes for the purpose, charters were given to private companies to construct and maintain roads, for the use of which a toll might be charged. On these roads, which were mostly macadamized, gatehouses were erected from three to five miles apart, and usually at the approach to all towns and villages, and at the entrance of bridges. Here the traveler must stop and pay a small fee for the use of the highway. This practice has almost entirely disappeared, although toll is often charged for crossing bridges as a means of defraying the cost of their construction. Some towns and counties also charge toll in place of a road tax. The practice is always unpopular, and although it has much to recommend it in new countries, where so much is to be done that the taxes are large in comparison with the wealth of the people, it has the great disadvantage of discouraging farm development.

PRIVATE ROADS

There are still millions of miles of roads in the United States that have never been regularly set aside as highways by any governmental authority. No one is responsible for their care. They are either kept open by use alone, or cared for by those through whose lands they pass, or who, for any reason, must use them.

According to the highway laws in most states, a road that has been kept open for a number of years for public use cannot be closed without the consent of the town, even though it has never been taken by authority or cared for at public expense. Many roads have this beginning, especially in country districts remote from large cities. When they come to be used for public purposes, they are more often than not found to offer the "longest way round." The perverse habit of climbing to the very crest of the highest hills, which is a characteristic of New England country roads, has this origin. In the early days, both for ease of clearing and protection from Indians, farmsteads were built on the tops of the highest hills. The roads were mere private wagon ways, worn by use, to these hill farms. They ramble about according to the order in which the neighborhood came to be settled, with the curious result that the most fertile land in New England is often the most inaccessible, and such roads as exist are by the most difficult possible route.



Copyright, Underwood & Underwood

MAKING NEW ROADS IN JACKSON COUNTY, MISSOURI

MODERN ROAD CONSTRUCTION

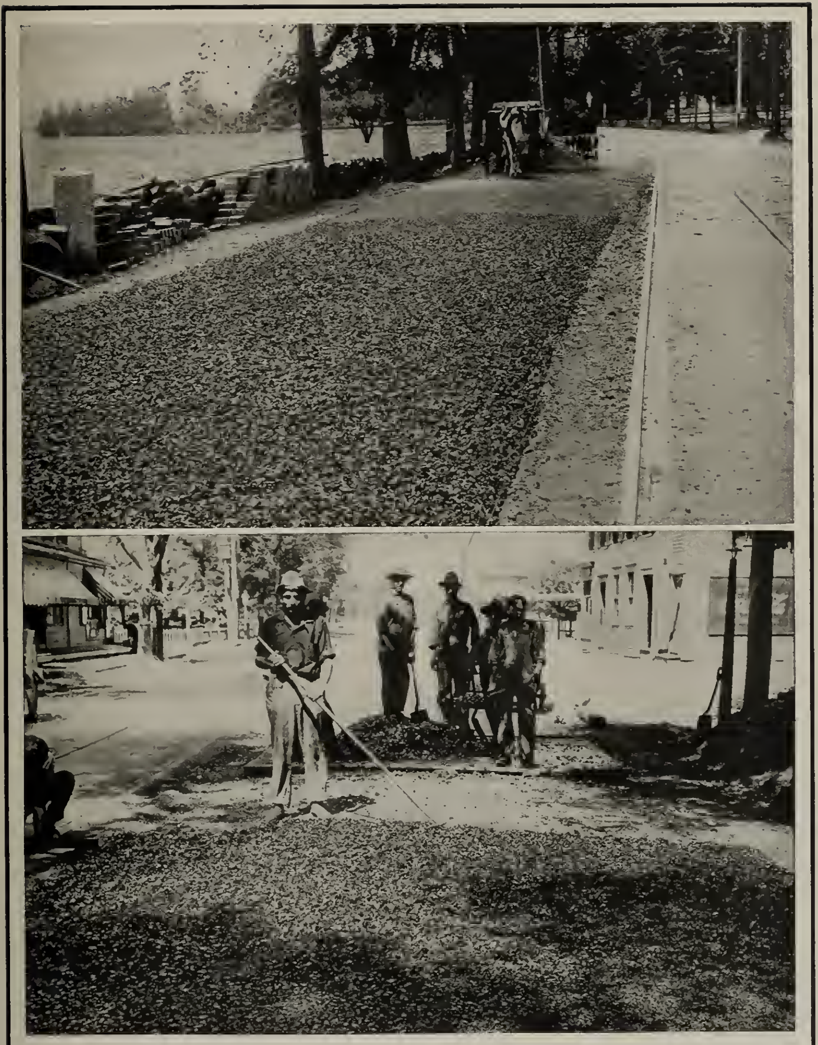
THE advent of the automobile has been the most important factor in the advance of road making in the United States. It is true that the appeal of the farmer for better highways and the economic necessity of making it easier for him to get his crops to market must be credited with a powerful influence in favor of desirable legislation; yet the motor car, with its exceedingly destructive effects on roads of the ordinary type and the intolerable dust nuisance created by these swiftly moving vehicles, has forced the good-roads problem on road commissioners and state legislators in such form that they have been obliged to give the matter immediate and thorough consideration.

What was a good road under former conditions may be far from satisfactory now. Gravel and macadam roads, however well made, are quickly pulled to pieces by the friction and suction of pneumatic tires, unless some form of binder is used. When the peculiarly destructive action of automobile wheels was first noted, it was believed that a surface application of tar or oil would be sufficient to remedy the trouble. It was soon found that while surface treatment helped, it was really much more economical, as well as more satisfactory in other ways, to construct the road throughout with a bituminous binder. Preparations of coal tar and asphaltic oil are commonly used and take the place of water, which was all that was needed before the day of the road-wrecking gasoline car. It is to be expected that the cost of a macadam road with such a binder will be somewhat more than for one made with water, but the reduction in maintenance charges will more than equalize this extra first cost. Without doubt a properly made macadam road, in which a bituminous binder is employed, may be considered the last word in highway construction for all-round use.

Unfortunately, macadam roads are costly and communities which have fairly good thoroughfares do not feel like investing in new construction work. Much may be done with old roads if they have a good foundation. The use of tar or oil retards deterioration and cuts repair costs. The best way to use these surface materials is to apply them in the spring and to cover them with a blanket of sand or screenings. This treatment will at least abate the dust nuisance for most of the summer. Another application in the fall is desirable in order to protect the surface during the winter months. This practice costs no more than sprinkling the streets with water, and the results are vastly more satisfactory. The oil or tar preparation may be applied with a spraying machine, a hose, or even with a watering can. Common watering carts are easily transformed into oil-spraying machines.

When streets in cities and towns are oiled, the road surface is first swept clean, the sweepings being left at the edges. Then the oil is

TOP: SPRAYING MACHINE FOR APPLYING ROAD OIL. BOTTOM: DIFFICULT CONSTRUCTION



SPREADING TARRED STONE

The tar seals the roadbed, making the surface shed water and reducing wear from the suction of automobile tires.

applied and spread with brooms, after which the sweepings are scattered over the oil. The addition of fine stone screenings is considered desirable. The screenings absorb the oil which does not penetrate the road surface, and it is important for the success of the work that they be used. It is an interesting fact that when this method of treatment is followed year after year, the amount of oil required continually grows less. The use of oil has given satisfaction even on the sand roads of Cape Cod, in Massachusetts. In sections where the traffic is very heavy, it has been found well to cover the oil rather heavily with screened and washed quartz. Any covering makes the oil somewhat less objectionable to property owners and prevents the road from becoming slippery in rainy weather.

If gravel is spread in layers and each layer rolled, it makes a fairly good road, but one which requires constant attention. The gravel should be screened to get out the earth, and the stones should be comparatively uniform in size.

THE ROAD DRAG

State roads, built in a first-class manner, are becoming more common, and many large centers of population are connected by thoroughfares which are above reproach. They show the possibilities of road making in the United States, but the fact must be faced that off the main arteries of travel most roads are built in the cheapest manner and have no top-dressing except ordinary soil. It is over such roads that the average farmer must take his produce to market, that his children must travel to and from school, and that he must make his pilgrimage to church on Sunday. The problem of what to do with the country road has been solved in a certain degree by the invention of the road drag, the "split-log" drag, as it is styled by its originator, D. Ward King, of Maitland, Mo. A widespread movement for the use of this device had its beginning in Iowa, where the Northwestern railroad sent a special train from the Missouri to the Mississippi rivers to advocate a campaign for better roads, with the split-log drag as the main implement to be employed. Later, other railroads in the West began the exploitation of this drag, with the result that the country roads were wonderfully improved.

A dry red-cedar log is best for a drag, but red elm, walnut, box elder, and soft maple may be used. The log should be seven or eight feet long and from ten to twelve inches in diameter. It is made ready for use by splitting it down the middle. The two slabs are held thirty

THE "SPLIT-LOG" ROAD DRAG

inches apart by stakes and are set on edge. A chain is attached and the drag pulled by one or two horses. As the road begins to dry after a rain the drag is hauled up one wheel track and down the other at an angle of about forty-five degrees, which tends to fill the ruts and hollows and moves a little earth toward the middle of the road. A good drag can be made for less than three dollars, and wonderful results are accomplished when the road is properly worked with this rather rude implement once a month throughout the summer.

Lancaster County, Pennsylvania, may be cited as an example of what can be done with the road drag. The farmers themselves do the work, and after several years' trial it has been found that the cost of maintaining the roads is less than before, while the roads themselves are in very much better condition. The cost of caring for a dragged road is estimated at twelve dollars a mile for a year.

THE ESSENTIALS

In the making of a good road, these things are essential — a suitable location, easy grades, and a smooth, hard, durable surface. There is no reason for a new road to have a poor location if a competent engineer is employed. In former days people believed that time was saved by

TOP: THE FINAL ROLLING. BOTTOM: APPLYING ROAD OIL

going over a hill rather than around it. Hills are now avoided as much as possible. A rise of one foot in from thirty to thirty-three is a good grade. It is important to have good drainage, and a slightly rounding surface will carry away rain water. Gutters and culverts are needed as a matter of course. Oblique mounds across

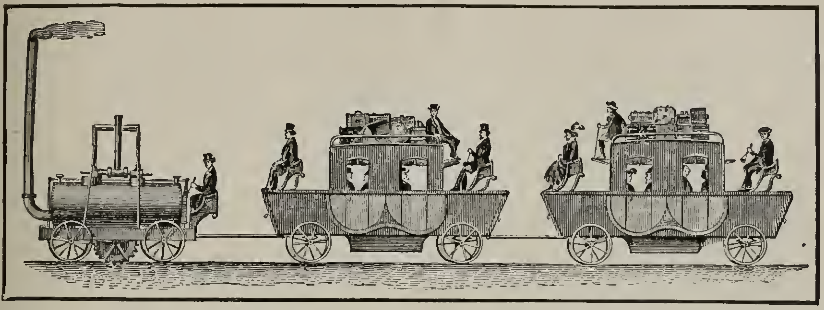
A MODERN COUNTRY ROAD

Signs and heavy guard rails decrease the danger of the curve.

country roads on steep hills, to carry running water to the sides, were common up to a few years ago, and were frequently spoken of as "Thank-you-ma'ams." They have gradually disappeared since the coming of the automobile. Where the soil is wet clay or full of springs, it will be necessary to lay tile drains.

Paved streets are usually laid in thickly settled communities. Paving is not new, however, for some of the streets in Rome were paved long before the Christian era. Cobblestones were laid in New York as early as 1650. Asphalt has come to be a very popular paving material in America, and is laid over a concrete foundation. A street thirty feet wide is given a four-inch crown in order to carry the water to the sides. The one fault of asphalt is the fact that it is slippery in wet weather. Horses fall and automobiles skid on it. It is the easiest paving material to keep clean, however; it looks well and is less noisy than stone and brick. Of course, stone paving blocks are exceedingly durable and they are still in very general use. Being cut square, they do not give the uneven surface of cobblestones. They are noisy, though, and because of the wide joints are very difficult to clean. Wood blocks are growing in favor, especially for residential sections, for they deaden the sound of horses' hoofs to a greater extent than any other paving material. In some sections bricks are very cheap, and when that is the case are to be recommended. The life of various materials is given by Tilson as follows: Granite blocks, 20 to 25 years; asphalt, 18 years; brick, 15 years; wood, 10 to 15 years. Eight years is given as the length of time a macadam road may be expected to wear in a city or town before radical repairs are needed.

It is an interesting fact that modern road construction is based to a large extent on the theories of men who lived many years ago. MacAdam, Telford, and Tresaguet are the great names among highway engineers. MacAdam and Telford were Scots, one born in 1775 and the other a year later. Their names have been applied to two systems of broken stone road construction, both of which are now used in this country, although the macadam road is the more familiar. Tresaguet was a French engineer, who preceded the rival Scotchmen by about forty years. He laid the foundations of improved road making, and his system is similar to that now in use throughout the world. The use of tar or similar material as a binder, however, is entirely modern. A road made of broken stone bound with tar and covered with finely crushed stone with which oil or tar has been mixed and the surface properly rolled is perfectly adapted to modern conditions; except, perhaps, that it is sometimes cut through by heavily laden vehicles having narrow iron tires. In many sections wider tires are being advocated. Such roads shed water quickly, have a marked degree of elasticity, and are easily repaired.



Thomas Gray of Nottingham, England, was the first to agitate there the question of passenger cars. This drawing, of about 1820, shows his idea of a train.

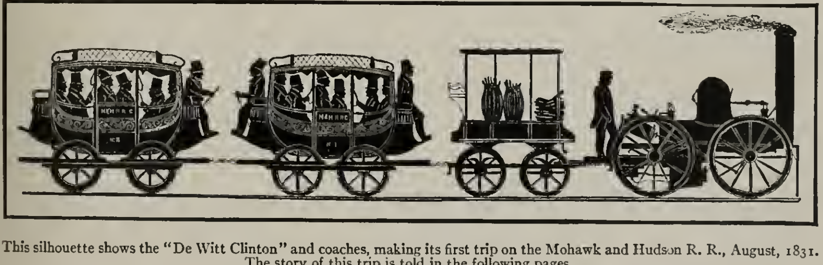
THE ROMANCE OF THE RAILROAD

THE story of George Stephenson, the inventor of the locomotive engine, is a story of faith overcoming great obstacles, a story of opposition, disappointment, and defeat suddenly transformed into one of the most complete triumphs that it has ever been the lot of man to enjoy.

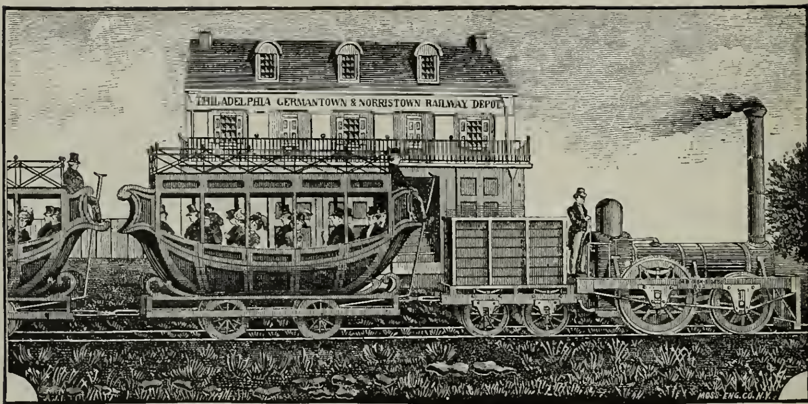
On September 15, 1830, the Liverpool and Manchester Railroad was opened with great rejoicing. A few days before this famous event, Miss Fanny Kemble, a noted English actress, was invited by Stephenson to ride with him on a trial trip in the cab of his engine. In a letter to a friend she says:

"He was rather a stern-featured man, with a dark and deeply marked countenance; his speech was strongly inflected with his native Northumberland accent; but the fascination of that story told by himself while his tame dragon flew panting along his iron pathway with us, passed the first reading of the Arabian Nights, the tales of which it almost seemed to recall. He was wonderfully condescending and kind in answering all the questions of my eager ignorance, and I listened to him with eyes brimful of warm tears of sympathy. He told me of all his alternations of hope and fear."

At about the same time railroading in the United States made a few feeble beginnings at widely separated points. Interesting though it is, we cannot go into the story of those early efforts, nor even trace in detail the course of development, so rapid as to be almost bewildering, by which the face of the earth and the daily life of mankind have undergone a veritable transformation.



This silhouette shows the "De Witt Clinton" and coaches, making its first trip on the Mohawk and Hudson R. R., August, 1831. The story of this trip is told in the following pages.



THE FIRST RAILROAD TRAIN IN PENNSYLVANIA, DRAWN BY "OLD IRONSIDES," 1832

THE FIRST AMERICAN RAILWAY

On February 26, 1826, the New York State legislature granted the first railroad charter in this country. It was for the Mohawk and Hudson River Road, and at the time there was not a railroad on the continent. The charter was granted to Stephen van Rensselaer of Albany and George W. Featherstonhaugh of Duanesburgh. The road was completed and opened for traffic August 10, 1831. In the time between the granting of the charter and the completion of the road, several short lines of track, variously operated, were built in different parts of the country, so that there will always be more or less discussion as to which road was the "first." On the whole, the little road from Albany to Schenectady has a good claim. At least, no one had ever paid a railroad fare until "Master of Transportation" John T. Clarke called out, "Tickets, please," to the prospective passengers for the first trip behind the famous American-built locomotive, the *De Witt Clinton.*

These tickets had been previously purchased in the hotel offices by persons from all over the state, who had come to witness the great event. The train consisted of five coaches; and coaches they actually were, built after the stagecoach pattern. They were coupled together by three long links — that is, they were for a part of the journey. After the passengers had been sprawled over the floor a few times by the jerk of this loose coupling, the Master of Transportation and the engineer, Dave Matthews, stopped the train and raided a farmer's rail fence, lashing the rails between the coaches in such a manner as to form a more rigid coupling.

THE FIRST TRIP

Having collected his tickets, the Master of Transportation walked forward to a little platform car, on which was a barrel containing an extra supply of water for the boiler and a few sticks of wood, and sat down. Having made himself ready, he drew from his pocket a tin horn and blew a mighty blast. That was the signal for Dave to "let her go," which he proceeded to do. Dave had secret misgivings as to the ability of his engine to start such a load as five coaches filled with passengers, so he had backed to the bumpers and, with a full head of steam, opened up the throttle. The result may be imagined. Heads were roughly jerked and tall hats lined the right of way. Dignified passengers were huddled on the floor, and not a few were lamenting sore bruises. But good nature prevailed. It was a glorious day. The *De Witt Clinton* had been built to

burn anthracite coal, but did not have draft enough to make much steam with so refractory a fuel. So for this trial trip the engineer had supplied himself with pitch pine. This soon covered the passengers with soot in good railroad fashion. It also threw out quantities of burning sparks, which kept the distinguished citizens of the commonwealth dodging at a lively rate. Some put up umbrellas, but these were soon burned up and thrown overboard. One or two of the passengers were unfortunate enough to have their clothing set afire, and much excitement was caused by the effort to extinguish these flames. One gentleman with steady nerves and a philosophic mind drew a notebook from his pocket and inscribed a line therein, to prove that it was possible to write while moving at such a terrific speed. The entire distance of sixteen miles, which was the total length of the road, was covered in forty-six minutes. Everyone was happy. Cannon were fired and speeches made up and down the country. The right of way was lined with spectators, and many were the runaway steeds, and deep was the astonishment of the farmers.

The experiment took hold instantaneously. Right away everyone wanted a charter to build a railroad. Forty-nine applications were made to the next legislature, and charters were actually granted in New York State alone to one hundred and fifty-one railroads in the next few years. Fortunately most of these were never built. But railroad construction in America had received an impetus similar to that which the building and successful operation of the Liverpool and Manchester Railroad had created in England in 1830.

HOW A MODERN RAILROAD IS BUILT

The modern railroad is a marvel of human genius. Its construction demands the utmost skill of engineer and inventor, and its methods of operation are a lesson in perfection. It is hard to realize that a hundred years ago there was no railroad anywhere, while now nearly the whole world is belted with iron tracks, and it is proposed to cross even the Desert of Sahara by rail. By bridge and tunnel every

AN AMERICAN PASSENGER TRAIN OF 1867

obstacle has been overcome. Let us see how a railroad comes to be.

HOW RAILROADS ARE BEGUN

Sometimes the citizens of towns and cities, ambitious for growth, stir up a sentiment among the people that grows stronger and stronger until some active person takes the step that starts the enterprise. Sometimes older railroads build branches and extensions to enlarge and strengthen their business. Oftentimes "promoters," for their private gain, manage to secure a charter and launch a new railroad. The first steps are usually taken with the utmost secrecy, so as to prevent land speculation along the right of way. Money is raised to pay the expenses of a scouting survey by able engineers, who find the most practicable route between the two points. Then application is made to the state for a charter; that is, for permission to build the road and operate it, and the right to enjoy the special privileges which the laws of all countries give to railroads as public necessities.

HOW THE MONEY IS RAISED

It costs a great deal of money to build a railroad, and it sometimes takes many years to raise the necessary amount. In many cases, where the country has recognized the usefulness of the road and the great cost of building it, the government has given financial help. For a long time now it has not been necessary for the United States government to do this.

Having obtained their charter, made their preliminary surveys, and estimated the probable cost, the organizers of a road usually apply to the great banks for the money, some banking houses making a specialty of handling such business. Much of the money that built the Canadian Pacific Railway was raised in France by a great house of bankers in Paris. The money is the savings of the French people, and represents the thrift of the peasant farmers. Is it not wonderful that the economy and industry of a French peasant can help to build a great railroad through an unknown wilderness on this side of the ocean? That is only one of the many wonderful ways in which railroading has brought the whole world together. In the early days of railroading in the United States, the money for building railroads came either from the government directly, or from the sale of lands given by the government, or from English and French bankers. Of late years the banks in our Eastern states have enough of the savings of the people to supply the money needed by newer sections of the country. The important thing to remember is, that such great enterprises as railroads can be built only by using the savings of the common people.

THE WORKING SURVEY

Before actual work is begun, and after the money has been raised, the preliminary survey is extended and carried out into the most exact and minute detail. This work requires great skill and sound judgment, and often much hardihood and courage as well. The engineers who surveyed the ways for our great Western roads were often killed by Indians. Their successors sometimes perished in blizzards or in mountain torrents, or died of hunger and thirst on the desert plains.

The engineer must so plan his road as to gain every possible advantage of the lay of the land and to lessen its unavoidable difficulties. He must consider the shortest way, the most level way, the least possible number of curves, the cheapest way to build and to maintain, the availability of material, such as timber and gravel, and many other similar things. You notice that the car sways as it rounds some curve; you hear the engine pant its way up some grade, and you think little of it. But many engineers have spent days and weeks, and sometimes years, studying these same grades and curves. Having settled such problems, and decided where to bridge and where to tunnel, where to cut and where to make embankments, how to cross this swamp and that mountain range, and having made a map and staked out the road, the engineer hands over the work to the builders.

BUILDING THE RAILROAD

Most of the railroads in America are built by contractors; that is, by men not connected

Copyright, Gifford; Northern Pacific Ry.

FROM STAGECOACH TO LIMITED EXPRESS

with the road who agree to build it in a certain time for a certain sum of money. There are many reasons for this. The most important one is that such contractors become expert at that work, and are able to find enough of it to do to keep a force of men and an equipment for the purpose. Another reason is that the contract fixes the price, and thus makes it easier to raise the money for building the road.

The contractor for the Canadian Pacific gave out the work to many subcontractors, each taking a section, and there were more than three hundred sections being built independently in this way at the same time. It requires a great many men to do the digging, shaping, and building of the roadbed. In America the greater part of this work is done by immigrants. At first the majority of these workers came from Ireland, but afterward more from the south of Europe. Lately in the West much of the work is done by Chinese and Japanese workers.

The work is usually begun at several points along the route at the same time; that is, if the road is a long one. These points are chosen on account of their nearness to some important source of supply, so that as the road is built supplies can easily be carried over the rails already laid. At these points of beginning great camps of laborers are established. It requires vast quantities of food to provision these camps, and many of them are as fully organized as a great city.

ENGINEERING FEATS

The bridges upon which railroads are carried across gorges, rivers, and valleys are among the most wonderful things that man has done. The story of these engineering achievements is told in later chapters. At Surprise Creek, on the Canadian Pacific Railway, is a huge trestle of wood that lifts the tracks three hundred and sixty feet above the level of the stream. The Great Western Railroad has been an originator of many bold feats. This road insisted for many years on a wide gauge for their tracks. The regular gauge now used the world over is four feet eight and one half inches. That is the gauge of the old coal wagons that ran on rails into the coal mines. This gauge was adopted to save the necessity of altering all of the existing mining equipment. It gradually came to prevail because of the very evident advantage of uniformity. The Great Western adopted a gauge of seven feet. Their trains were able to run at a higher speed than any others. But the refusal of all other roads to adopt the new standard at last compelled them to change, although they may have had the best of the argument.

FIGHTING THE ELEMENTS

Fire, flood, ice, snow, and storms of wind and sand are among the obstacles that railroads must conquer. In our country snow is the most expensive natural enemy of the railroad. Great sheds are erected over the exposed portions of the tracks all through the Northwest. These sheds extend for miles upon miles, and their erection and repair form one of the heavy expenses that the roads must bear. Huge snowplows, some of them working great fanlike wheels that bore into the snowdrifts, are used to clear the tracks where the sheds are not built.

In Mexico and our own Southwest, and in Africa, the sandstorm is a railroad's worst foe. It is difficult to guard against, and completely buries the track beneath solidly packed sand that must be laboriously dug out, unless another and kinder sandstorm comes along and decides to undo what its forerunner accomplished. As the country becomes settled the sandstorm will disappear, for the planting of trees and grass holds the soil down. But for many years to come the sandstorm will be the terror of the wilderness railroad in southern countries.

RAILROAD SPEED

The inventor of the locomotive prophesied that no train could regularly run at over one hundred miles an hour, and that speed was reached during a series of trial races soon after the building of the very first road. For a long time twenty miles an hour was the average for trains. Then it rose to thirty, then forty, and now the limited express trains average fifty and sixty miles an hour. The increase in speed has come largely from the improvement of tracks, brakes, and the minor equipment of trains.

CAÑONS IN THE WEST THROUGH WHICH THE RAILROAD WINDS ITS WAY

CROSSING THE CONTINENT — THE UNION PACIFIC

FIRST, as always, came the preaching of the "cranks." Judge S. W. Dexter of Ann Arbor, Mich., began the crusade for a road to the Pacific Ocean in a paper called the *Weekly Emigrant*, which he owned. That was in 1832 and only six months after the building of the first little railroad in America — the road from Albany to Schenectady.

In 1836 a Welsh engineer named John Plumbe stirred up enough interest to get a convention called and a resolution introduced into Congress but not enough to interest anyone with money to spend. After Plumbe came Asa Whitney, a wealthy New York merchant. Whitney preached Pacific Railroad night and day, besieging Congress, state governors, bankers — everyone. He offered to build the road himself if Congress would give him a strip of land sixty miles wide across the continent! He died a poor man. Then came Josiah Perham of Boston. Perham had been a wool manufacturer and had made money. He became interested in railroading and organized the first popular excursions, which proved to be very successful, and out of which he made both fame and wealth. He caught the Pacific Railroad fever and, like Whitney, spent his all in a vain effort to get something done. But these men had not worked in vain. They had made the Pacific Railroad one of the big questions of the day. Nobody was ready to risk money in the enterprise as yet, but everyone was talking about it. About 1854 an engineer named Theodore D. Judah went West to build the Sacramento Valley Railroad. Unlike the other men who before him had become infatuated with the idea of a transcontinental road, Judah was a practical railroad man, a graduate of the Rensselaer Polytechnic Institute at Troy, N. Y., and he undertook nothing beyond the means in sight. He found a pass by which the Sierra Nevadas could be crossed at a maximum grade of 105 feet to the mile and at a cost of $150,000 a mile. Those who had gone before him only dreamed about costs and routes. On his wonderful survey Judah took his wife with him, and she fished for trout to supply the table of the workers while the men worked. She was an artist and made sketches which were afterward used on the stock certificates of the Central Pacific Railroad. When he was through, Judah drew a profile map of his route on the counter of Strong's drug store at Dutch Flat. That was the genesis of the actual transcontinental railroad. Then he went back to Sacramento and called together his friends, a group of storekeepers whose names afterward became the magic words of railroading. These men were C. P. Huntington, Mark Hopkins, and Leland Stanford. At last, in June, 1861, the Central Pacific Railroad Company was organized with a capital stock of $125,000, and the whole community turned out to laugh at the idea of a few town storekeepers with that amount of capital building a railroad across the country. But these men were not the kind who cared much about the laughter of the mob. Judah was sent East to raise money. He did not succeed. Finally these stalwart pioneers saw that it was a case of doing or dying. The spirit in which they went to work may be seen from a single incident. Orders went out for the building of a general office building for the road. An architect presented plans. C. P. Huntington looked them over.

"How much will they cost?" he inquired.

"Twelve thousand dollars," said the architect.

"But, man, we have got to pay the bills ourselves!"

Then, taking a piece of chalk, he drew on the floor a plan, and it became the plan of the "general offices" of the road. It cost just one hundred and fifty dollars to build that palatial structure.

On July 1, 1862, President Lincoln signed a bill granting $48,000 a mile to any railroad building a transcontinental line. With this encouragement the Union Pacific Road was organized and began construction at Omaha, Neb., building westward.

The early struggles of the crossing of the great plains by the Union Pacific is a long tale of Indian massacres and engineering marvels. Of the Union Pacific, in its early days, Oakes Ames of Boston was the leading spirit. Unhappily the financial operations of the road became involved with that of the Credit

Mobilier, one of the worst financial scandals America has ever known. The credit of the road was so bad that workmen demanded each day's wages in advance before they would go to work. Still the railroad crept westward, inch by inch, mile by mile. Capital was difficult to interest, even after government aid was so increased that a profit on the venture seemed inevitable. Omaha was as far off then to Eastern minds as San Francisco itself, and what did a railroad from Omaha signify?

In the meanwhile, although the dauntless Judah had died, the C. P. Huntington group was pushing the railroad eastward. In September, 1866, the rails reached Alta, seventy miles east of Sacramento, at an elevation of 5625 feet. Two months later the line had been extended twenty-three miles farther east to Cisco, mounting 2286 feet in that distance, and was within thirteen miles of the summit of the range.

On the Union Pacific end of the line the hostile Indians were so determined that the men were organized into a semi-military camp and marched out to work to the beat of drums. As a matter of fact, they were many of them veterans of the late war. As soldiers will, they put their hardships into song, one of which became a popular air of the day. It went something like this:

> "Then drill, my paddies, drill;
> Drill, my heroes, drill;
> Drill all day,
> No sugar in your tay,
> Working on the U. P. Railway."

In the midst of these hardships the intrepid spirit of General G. M. Dodge was the mainstay of the work. He warded off and punished the Indians, and organized the camp life and defense. He was also ingenious in the discovery of ways and means, and more than once helped out the faulty work of the engineers by the boldness of his explorations.

On one occasion the Indians attacked a train when General Dodge was not far away. As soon as he was notified, the general called for volunteers. Half of the men fell in like veterans, which indeed most of them were. The engine was coupled to the general's private car, which was a small arsenal on wheels, and the party rushed for the scene of action. So quickly was this done that the Indians were still busy gathering and dividing the plunder when the rescuers reached the spot. The veteran soldier-workmen fell into line and, in perfect military order, deployed, surrounding the marauders so effectually that not one escaped. It was work like this that made the name of General Dodge famous and the building of the Union Pacific possible.

As the two roads approached completion, money difficulties vanished. It was at last realized that a work of limitless possibilities was a fact, not a dream. The last few miles of construction became a race between the construction parties.

A space of only one hundred feet was left between the ends of the two tracks on May 9, 1869. On the following day Leland Stanford, representing the Central Pacific, Vice President Durant, and Directors Dillon and Duff of the Union Pacific, arrived on the scene, and preparations were made for celebrating the driving of the last spike.

DRIVING THE LAST SPIKE

Such a mixed crowd as only the West of that day could bring together gathered to watch the ceremony. There were Mormons, Mexicans, Indians, Chinese, Irish laborers, army officers and their wives, mule skinners, gold seekers, backwoodsmen, settlers, and Eastern bankers — as nondescript and motley a crowd as ever met.

The ceremonies were opened with a prayer by Rev. Dr. Todd of Massachusetts. Then a Chinese laborer smoothed the ground where the last tie was to be laid. This tie was a handsome piece of laurel wood, beautifully polished, brought from California. It was placed by the superintendents of construction of the two roads — the Central Pacific and the Union Pacific. A silver plate fastened to the tie bore the inscription, "The last tie laid in the construction of the Pacific Railroad, May 10, 1869."

Spikes of gold, silver, and iron from Arizona were handed to Vice President Durant of the Union Pacific, and, when he had driven these, a spike of pure California gold was handed to Leland Stanford. The man who began the

work six years before amid ridicule and scorn drove the last spike that marked its completion, adding billions of dollars to our national wealth and welding East and West into one nation.

All over the country cannon boomed and bells were rung. Services were held in churches. San Francisco was decked with bunting and the city went wild with genuine happiness. To them it meant more than words could tell.

The men who risked so much in the work made a profit of $16,710,000 from the government bounty. The road was immediately profitable; the Central Pacific earned $1,703,000 in the first three months of its operation.

HOW A YANKEE BOY BECAME A RAILROAD MAGNATE

The story of railroading in the United States would be incomplete without further reference to Collis Porter Huntington, who was born in Harwinton, Conn., April 16, 1821. It was the old story of poverty, large family, thrift, and hard work that constituted the training of so many great Americans. His first work was for a neighboring farmer for seven dollars a month. He saved all of this, and managed to gain a little credit in addition, sufficient for the purchase of a small bill of goods with which to open a store.

In 1848, at the beginning of the gold fever, he went West with twelve hundred dollars' capital. By shrewd trading he soon increased his capital to five thousand dollars. Locating in Sacramento, he formed a partnership with Mark Hopkins and established a hardware store. He helped to pay for his stock and its shipment from San Francisco by working for the boat owners at the excessively high wages then being paid in California.

By 1856 the firm of Huntington & Hopkins was one of the wealthiest on the Pacific slope. He avoided all temptation to speculation in mining, but when Theodore Judah came along with his Pacific Railroad project, Huntington saw its value and backed it to his last cent. After the completion of this monumental enterprise, Huntington became one of the great railroad managers of the country. He controlled and operated the Southern Pacific, the Chesapeake and Ohio, the Kentucky Central, the Louisville, New Orleans and Texas, and many smaller lines, including the Mexican International and the Guatemala Central. A glance at this list shows that to the end his interest in opening new territory was very keen. By his operations he became a very wealthy man, built a fine mansion on Fifth Avenue in New York, contributed to many public and private enterprises and charities, and retained to the last his clearness of vision and his influence over his associates. At his death his fortune was estimated at eighty million dollars.

THE NORTHERN PACIFIC

The completion of the Union Pacific and its immediate prosperity, far from satisfying the demand for a transcontinental line, only aroused a keener desire among other communities than those reached by that route for similar advantages. Indeed, there had been sharp competition from the beginning between three proposed routes, each of which ultimately received a charter and built a road. The Northern Pacific bill passed Congress within two years of the Union and Central Pacific bills. Roughly speaking, this road was to follow the forty-ninth parallel, as the Union Pacific followed the forty-second. It may be briefly described as a road running from Chicago to Tacoma, Wash., by way of the upper Missouri River and Columbia River valleys, crossing the divide in southern Montana, a little to the north of the Yellowstone National Park, which is bounded on the north by the Montana line. The road has numerous spurs and branches, some so important as to rival the trunk line.

For some years no dominant force was felt in its affairs; but in 1881 Henry Villard secured a controlling interest and became its president. Mr. Villard was a notable man, whose picturesque career had resulted from his own force of character.

HENRY VILLARD A SELF-MADE MAN

He was born in the old imperial city of Speyer on the Rhine in 1835, and emigrated to America in 1853. He drifted into journalism after some effort to study law, and after a short stay in

Courtesy of Denver & Rio Grande R. R.

TOP: MARSHALL PASS, THE GREAT CONTINENTAL DIVIDE, COLORADO. ALTITUDE, 10,856 FEET. BOTTOM: CAÑON OF THE "RIVER OF LOST SOULS," COLORADO

several cities found his way to Chicago. He became a traveling correspondent of considerable fame, and at the outbreak of the Civil War was sent to the front as a war correspondent. While thus engaged, he took a trip to Boston, where he met and married the daughter of William Lloyd Garrison.

Villard established the first correspondence bureau in Washington, serving with his dispatches an important group of papers. For several years after this experience he traveled back and forth between Europe and America, serving as correspondent and editorial writer on many important papers. While thus engaged he was approached by German banking interests with reference to representing the foreign investments in the Northern Pacific. This charge he ultimately assumed and, in the process of following his new duties, found himself at the head of one of the world's greatest transportation systems. Under his management the road was completed as a highway between the Atlantic and the Pacific oceans.

The marvelous wealth of the country through which the Northern Pacific enters the great West, as well as its romantic beauty, gives it an importance which every year enhances. It is the Northern Pacific that carries the commerce of Asia and the products of the northwestern territories to the Great Lakes, to be loaded on the huge freighters that ply those mighty waters. It is the Northern Pacific that brings to the great markets of the world the beef of the Montana ranch, the wheat of the Dakotas, the copper of the Superior district, and the timber of Oregon and Washington. It is by the Northern Pacific that thousands annually seek that great wonderland of Nature, the Yellowstone Park, with its amazing varicolored rocks, mighty cañons, boiling springs, and mysterious geysers.

THE SOUTHERN PACIFIC

Another of the alternate routes proposed at the time of the building of the Union Pacific was that known as the thirty-second parallel route, and later as the Southern Pacific. Whatever chance of special favor this route might have had was brought to an end by the outbreak of the Civil War. But as soon as peace was firmly established and the minds of men began to turn again toward great projects of national development, the Southern Pacific route began to be urged anew. Congress was induced once more to grant aid by offering public lands to the builders. The state of Texas also made a similar gift and, in all, the road was promised, upon its completion, the enormous total of thirty million acres of public lands. Through the purchase of four short lines, by the year 1883 the Southern Pacific was able to open a continuous route from New Orleans to San Francisco, by way of Galveston, Texas, with the aid of a fleet of steamers, reaching New York, Havana, Cuba, and Vera Cruz, Mexico. Much of the land traversed by this route is still very wild. The building of the road was made dangerous and difficult by the Apache Indians, who became skilled at train wrecking and were relentless and cunning in surrounding and cutting off section gangs and construction parties. They burned bridges, overthrew and choked water supplies, and in a short time put the section practically in a state of war — a war of civilization against savagery. In such a struggle there could be no doubt as to the victor. Slowly and sullenly the Indian withdrew across the Mexican border, where he still lurks among the Western mountains.

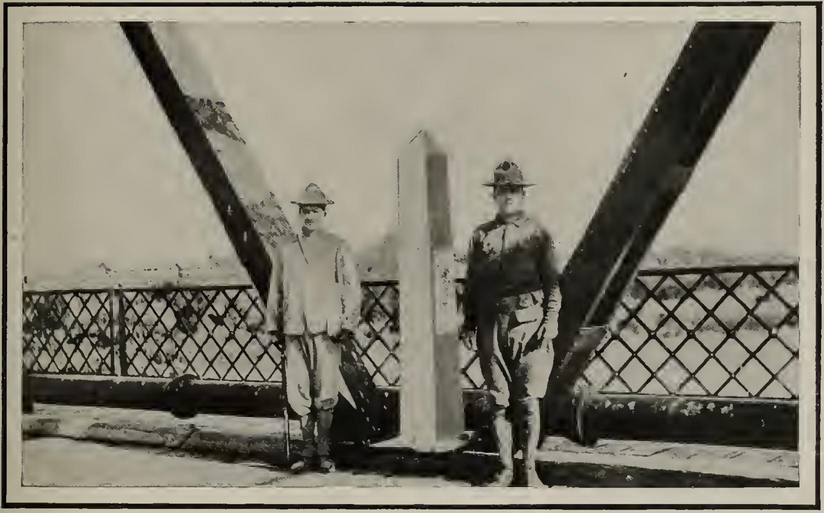
THE SANTA FÉ ROUTE

A fourth route to the Pacific was completed at about the same time as the Southern Pacific. This was the Atchison, Topeka, and Santa Fé. By this route there is now a through line from Chicago to the Gulf of California, with branches to Los Angeles and San Diego. This was the last of the great railroads to be aided by land grants. Construction work began in Kansas, and the Gulf of California was reached in 1882, eighteen years after the granting of the charter.

By the Santa Fé route important sections of Kansas and great territories in New Mexico and Arizona are opened up. While much of this has been considered a barren waste, recent progress in agricultural methods is proving it to be one of the most fruitful sections of the land, and its future, through irrigation and the change in rainfall caused by the ever increasing

areas under cultivation, seems likely to make it one of the garden spots of the earth.

It is impossible that a railroad should cross that great American wonderland, the Rocky Mountains, without opening up new scenes of natural beauty and grandeur. The great feature in this respect of the Santa Fé system is the Grand Cañon of the Colorado River in Arizona.



Copyright, American Press Association

AT THE BOUNDARY BETWEEN THE UNITED STATES AND MEXICO

THE GREAT NORTHERN

The last of the routes to the Pacific through the territory of the United States is the result of the enterprise and energy of a great railroad pioneer of the Northwest. The Great Northern completed in 1893 a line from St. Paul to Puget Sound by a route just south of the Canadian border line and to the north of the Northern Pacific. It has an important branch running up into the province of Manitoba, Canada. The development of this route is really the life story of James J. Hill, a Canadian by birth. Young Hill was destined for the medical profession, but the death of his father threw obstacles in his way. After some work as a youth in local mercantile establishments, he came to the United States, settling at St. Paul. There he obtained employment as a shipping clerk for the Mississippi River Packet Company. Seeing an opening in the coal supply of this growing district, he interested himself in that field and brought the first mineral fuel to St. Paul. In this employment he laid the foundations of a considerable fortune. When the St. Paul and Pacific began to operate its short line of trackage, Hill became station agent and threw himself into the development of that property. There he found his real place. By his energy and resourcefulness he secured the extension of the line to Manitoba, Canada, and presently became general manager. Gradually the road pushed out its connections, until a through line from the Great Lakes to the Pacific Ocean bore the new name given to the system, the Great Northern. And that indeed it is — a great northern highway along the borders of our country. In connection with its railroad the Great Northern operates a steamship line

to Asia, and has other important steamship connections, making it one of the world's great systems for the shipment of goods and for travel. Mr. Hill became a leader in the development of the Northwest, and will take a place in history as one of the builders of that magnificent section of our country.

OPENING THE NORTHWEST — THE CANADIAN PACIFIC

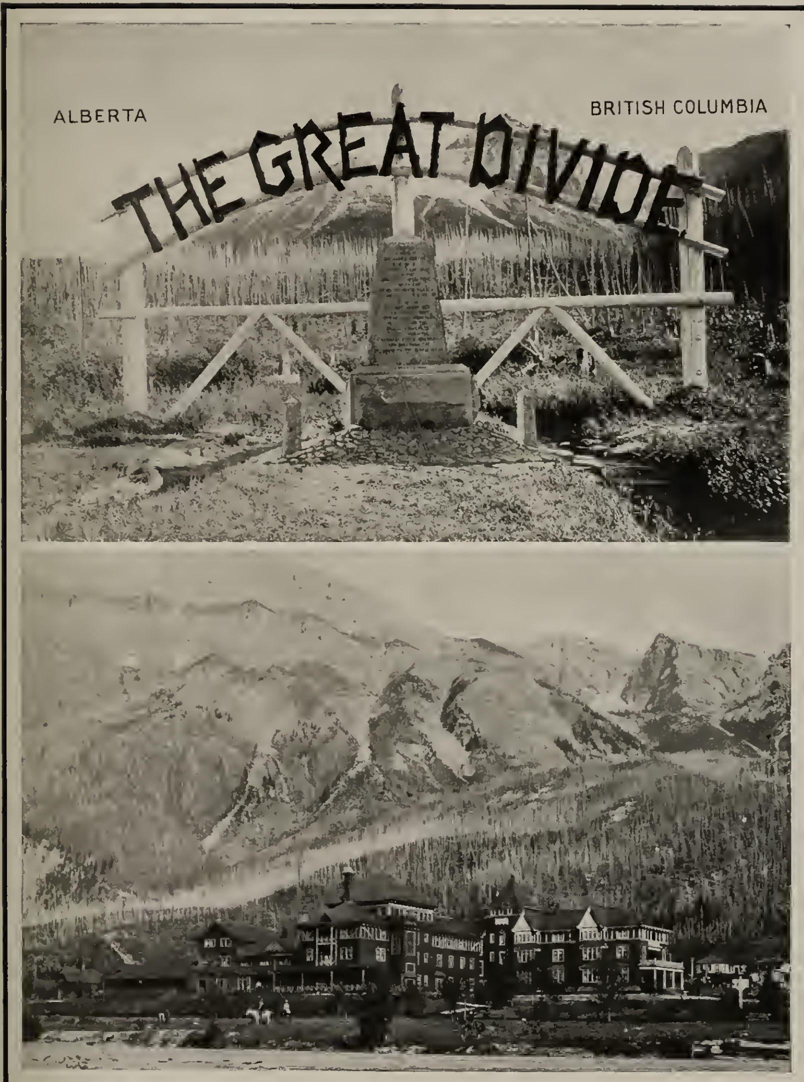
WHEN British Columbia became a part of the Dominion of Canada, it was agreed that a railroad should be thrown across the continent, uniting the Pacific coast of that province with Ottawa, the capital of the Dominion, and thus with the St. Lawrence River and the Atlantic. The accomplishment of this task became a charge of the government under the premiership of the great Sir John Macdonald. The greater part of the distance was unsettled and unknown, save as a wild mountainous desert. The preliminary surveys cost the government nearly $4,500,000 and required six years. The distance was twenty-five hundred miles. It was agreed that the company should receive from the government twenty-five million dollars in cash and twenty-five million acres of land, and that all materials needed for construction should be imported free of duty. The sections which had been begun by the government should also be handed over to the company free of charge. The company promised to complete the road by May, 1886. In order to do this it was necessary to lay four hundred miles of track a year through country only less difficult than the Rocky Mountains in the United States. The company decided to abandon the route laid out by the government at such enormous cost, and to make a new one several hundred miles farther south.

The food for men and horses and the commonest necessities of all kinds had to be brought a thousand miles overland to the point of construction. Extraordinary wages had to be offered to induce men to endure the possible hardships of the undertaking. Sixty building parties were established at different points, and over three hundred contractors engaged in the work. The materials had to be transported from seven to fifteen hundred miles. In advance of the track-laying party were two bridge-building gangs, one working days and the other nights. Where not a stick of timber was to be found, and nothing but a few surveyor's stakes indicated the possibility of a railroad, twenty-four hours later swung a great bridge spanned by shining steel rails, with a locomotive hauling a construction train puffing slowly over it. To feed the army of men and animals employed required vast amounts of food. The horses ate sixteen hundred bushels of oats a day, and the men used two freight cars of provisions every twenty-four hours.

The last two parties, one working east and one west, finally met at Eagle Pass in the Gold Range. Two days before this the first trans-continental train was dispatched from Montreal. On November 5, 1885, the last spike was driven that completed the Canadian Pacific Railway. No ceremonies marked the event. It was driven firmly into position by Sir Donald Smith, in the presence of a few persons, and then the small party went off to fish. Quiet as was the event, the news of it made a profound stir in the commercial world. Many a family talked that night over the chances of starting a new home in the great Canadian wilderness thus opened up to settlement and prosperity. The wonderful story of the growth of our own Western country is now being repeated in Canada. Where a virgin forest stood as late as 1886, now rises the populous and well-built city of Vancouver, which is destined to be to Canada what San Francisco is to the United States. Hundreds and thousands of homes and villages dot the great prairies, with millions of dollars in cattle and improvements.

READY FOR THE SETTLER

The most desirable country has been accurately surveyed and laid out for settlement. Each square is six miles to a side and is divided into thirty-six sections of a square mile each. Each section is divided into quarter sections of one hundred and sixty acres. All the sections are regularly numbered, the odd numbers becoming the property of the Canadian Pacific Railway and the even numbers of the government. Two sections in each township are



Courtesy of Canadian Pacific Ry.

IN BRITISH COLUMBIA

In the upper view is sbown tbe Great Divide between Alberta and British Columbia. Notice the spring behind the monument. The stream flowing from it on the British Columbia side finds its way through the Kicking Horse and Columbia rivers into the Pacific; that on the Alberta side finally reaches Hudson Bay. In the lower view a mountain railway station, witb its accompanying botel, is sbown in tbe foreground, witb Mt. Stephen, 14,000 feet above sea level, in tbe background.

reserved for school purposes. The government lands are open free to settlers, each settler receiving a quarter section. This wonderful change wrought in a few years gives a vivid idea of what railroads can accomplish in advancing civilization and culture. If Vancouver is to be the San Francisco of the Canadian Northwest, it would seem that Winnipeg is to be the Chicago of the Canadian Central West. Thirty years ago a lonely fort built by the Hudson's Bay Company to guard the river highway into the still more inaccessible wilderness was the solitary sign of human habitation where now a great and thriving city stands. Winnipeg has already gathered to itself many of the improvements that usually come only with age and long effort. It has the air of an old and settled town.

Leaving Winnipeg and traveling westward, for two days the fast express rolls over sweeping prairies — a country that is yet to support a vast human population. After traversing this empire of fertile lands, we come to the Canadian Rockies, a thousand miles west of Winnipeg.

At the busy little town of Calgary the engine begins to feel the drag of the heavy upgrades. Higher and higher, by long slants and winding curves, through gorge and defile, mounts the laboring train. At Banff, in the heart of the wildest and most picturesque scenery, the Canadian government has reserved a park of two hundred and sixty square miles so as to preserve for future generations the beauty of wild Nature. A few miles beyond Banff the train passes the Great Divide, and from there the grade is reversed and the train glides downward, often with steam shut down. Down, down goes the track, over bridges that are marvels of the engineer's skill and on ledges hewn from the solid rock, while the great mountains tower overhead, almost excluding the daylight.

Hardly has one passed the Rockies, however, before the upgrade begins again. The Selkirk Range must be crossed. This ascent to an altitude of forty-five hundred feet is accomplished by sixty wonderful curves and loops, passing through dense forests. Having mastered the Selkirks, the engine must breast the Gold Range and the last mountain chain of the continent, the Cascades. The Fraser Cañon, through which the railroad crosses the Cascade Range, is one of the most sublime spectacles in the natural world. Its depth is so great that the river at the bottom roars through almost black darkness. Thence the route lies downward to the Pacific at Vancouver.

A continent has been crossed, with its cities and plains, its lakes and rivers, its mountain ranges and fertile valleys, its silent defiles and rocky fastnesses — all belted by the line of gleaming rails. Who can look into the future and see this great expanse when it shall become the scene of activities and the home of a civilization perhaps more prosperous than that of any of the ancient countries of the Old World?

CONNECTING LINKS

THE transcontinental lines were made by various connections from Chicago to the seaport cities of New York and Boston. The Eastern lines were built first, and when the Union Pacific and other Pacific coast lines were built, they made combinations. Thus one line is formed with the New York Central and Hudson River Railroad as the link from Chicago to New York. Another has the Pennsylvania Railroad and another the Baltimore and Ohio, while the Erie is still another part of the trunk-line system. What is commonly known now as the New York Central system includes the Michigan Central, the Michigan Southern, and various smaller lines. It took years to bring about the combinations that have given us great trunk lines.

THE NEW YORK CENTRAL

Although one tiny section of the present road lays claim to be the beginning of the railway in this country, there was no real New York Central until the time of Commodore Vanderbilt, who welded together the many parts of which it is formed. It is true that by 1843 through traffic between Albany and Buffalo was advertised; but this through service consisted in changing cars seven times and buying seven separate tickets, to say nothing of rechecking baggage seven times. It took

three more railroads, as late as 1853, to go from Buffalo to New York City. But in that year the ten lines which made up the service from New York to Buffalo were united in what was named the New York Central and Hudson River Railroad, now one of the great railroads of the world. It was made so undoubtedly by Cornelius Vanderbilt, who had cleared twelve millions — a vast fortune for that day — out of steamboats and ferryboats and decided to put his money into railroads. Getting control of the small roads and uniting them, he immediately set to work to improve the property and make it the best road then possible. The results were astonishing and a revelation to the world of the financial possibilities of a great railroad property properly managed. Mr. Vanderbilt was not content until his lines reached Chicago, the great central junction of the railways of the United States.

GEORGE PULLMAN AND THE SLEEPING CAR

The New York Central ran what was called a sleeping-car service as early as 1859. The cars were nicknamed "hyenas," on account of the fearful noise they made. Sleep was an impossibility. The berths, or bunks, were arranged in tiers of three, and were nothing more than narrow shelves on which it was impossible to sit erect and difficult to lie down. There was no bedding. In the end of the car was kept a pile of mattresses and pillows to which each passenger might help himself, if he wished to risk the subsequent torture.

On one of these cars in that eventful year, 1859, George Pullman, then a young man twenty-eight years of age, was a passenger. It occurred to him then and there that a great opportunity awaited the man who could introduce a real sleeping car. He had recently cleared twenty thousand dollars by raising houses to the legal grade in Chicago. George Pullman was born in Chautauqua County, New York. He was apprenticed as a cabinetmaker, and later gained experience in moving buildings for the widening of the Erie Canal, the knowlledge so gained enabling him to take advantage of the peculiar situation in Chicago when the legal street grade was raised.

Full of sleeping-car ideas, Pullman went to Chicago and persuaded some railroad to begin a half-hearted experiment, which was soon abandoned. Later he persuaded the Chicago and Alton Road to run a Pullman sleeper, "provided he would build it at his own expense." This he did, naming the car the "Pioneer."

It cost eighteen thousand dollars to build, and much unfavorable comment was aroused among railroads at the extravagance of its decorations. The average cost of railroad coaches at that time was about four thousand dollars each. Moreover, the car was larger than any then in use, and the steps were lower. Its use would necessitate the lowering of station platforms and the raising of bridge timbers overhead. Railroad men laughed at the idea of changing their roads to suit his cars. Pullman, however, refused to change the car. It ran on a short stretch of the Chicago and Alton and was as favorably received by the public as it was unfavorably regarded by the railroad world. The next car which Pullman built, instead of conforming more closely to the railroad standards of the day, departed still more widely from them.

It cost twenty-four thousand dollars and was larger and more elaborate than the first. Here and there he managed to find a place for his cars, and wherever they were used the public flocked. The roads using them increased their patronage. A revolution had taken place. Pullman had actually forced the raising of all bridge overhead structures and the lowering of all platforms on all well-equipped roads so as to permit of the running of his cars. The only problem now was to build them fast enough to meet the demand. He organized car works in several cities, but later moved his operations to a site near Chicago which he named Pullman, where he proceeded to build not only railroad cars but a model town. Pullman, Illinois, as the first industrial city built with the idea of giving ideal conditions to labor, was itself an event. George Pullman is to be regarded as one of the great constructive geniuses of our country, and the Pullman car is now known the world over.

THE ERIE RAILROAD

Few roads have struggled more bitterly against heavier odds than the Erie, but it has

played an important part in railroad development. Many of the features of modern railroad operation were first put into practice by the Erie.

It was the Erie, for example, that devised the signal rope to the engineer and placed the conductor in charge of the train. On all other roads the engineer was in charge and the conductor was a mere ticket taker. Conductor Henry Ayers has the honor of having settled "who's who" on a railroad train. He did it in Homeric fashion by thrashing the engineer, a big German named Hamel. Ayers had rigged a rope with a billet of wood on the end from his car to the engine as a signal to the engineer. Hamel broke the rope and threw away the stick. After several repetitions of the offense, Ayers turned in and thrashed the engineer into submission. Other conductors immediately adopted the signal system, and the bell rope has been in use ever since as the symbol of the conductor's authority. Another Erie conductor invented the ticket punch. The road was suffering from unprincipled travelers who were able to outwit the trainmen by the ticket system then in use. The punched ticket settled the business.

The Erie first practiced running trains by telegraphic orders. The telegraph had been installed for years before anyone thought of doing that. If one train failed to meet another, the road was tied up for hours. It was necessary to send a flagman, who walked until the train from the opposite direction was reached. Then there was a discussion as to which had the right of way and which should back up to the nearest siding. One day Superintendent Charles Minot of the Erie was on board a train so held up. Jumping from the car, he went to the nearest telegraph station and sent an order, "Hold eastbound train till further orders." That was the first train order ever sent, and it nearly caused a suspension of business. The trainmen vowed that they would not tolerate such an innovation. There was another brief struggle to decide the question. And again it was demonstrated that the man with progress on his side was the master of the situation. From that time, until the introduction of telephones, the telegraph was considered indispensable in the management of a railroad.

THE PENNSYLVANIA RAILROAD

Two great names in railroading are connected with the development of the Pennsylvania Railroad — John Edgar Thomson, the president, who was a builder, and Matthew Baldwin, the founder of the great Baldwin Locomotive Works. The Pennsylvania project met with determined opposition from the old Quaker merchants of Philadelphia and the farmers of the neighborhood. The merchants said that the old ways were good enough, and the farmers said that the road would bring in outside produce so cheaply that their business would be ruined. This latter prophecy was abundantly verified, but the farmers received such prices for their land as building lots for the growing city that one acre was worth more than the old farm could make in ten years.

In the early days a curious device was employed to check railway progress. Everybody had a right to use the track with his own vehicles drawn by any power he chose, if he fitted them with flanged wheels and paid a "wheel toll." How it was possible to operate a "railroad" under such conditions it is difficult to see. The confusion was indescribable. A stubborn Dutch farmer could put an ox cart on the track and, as there was no possible way of passing him, hold the "through expresses" to his own gait.

THE CHESAPEAKE AND OHIO, AND BALTIMORE AND OHIO

These two great systems, passing through the beautifully scenic country of the Virginias and the fertile Ohio valley, owed their origin to business men. They had pinned their faith to canals, but saw their region losing its supremacy. At last the railroad gained favor and these two lines were built to divert Western business to Baltimore. It was not possible for the ambitious Baltimorians to overcome the enormous advantage possessed by New York through her great inland waterway. But the country was greater and its resources vastly larger than anyone at that time realized. The two routes through the Virginias have carried all the traffic that they are capable of handling and are important links in the country's railroad connections.

AN ENGLISH LOCOMOTIVE

RAILROADS IN OTHER LANDS

IN ENGLAND

THE American traveler's first observation of an English railroad usually arouses amusement, which, however, quickly gives way to admiration. The engines and coaches, and especially the freight "wagons," as they are called, seem like toys beside those to which he is accustomed. The shorter hauls, lighter grades, and superb roadbeds make it possible to use much lighter rolling stock than is possible for American trunk lines. The passenger applies to a guard, who assigns him a seat in a "compartment" holding six persons, three on a seat, the seats facing each other. The door is shut from the outside, and there he stays until the next station is reached. The largest coaches contain three or four such compartments, and in the newer ones a corridor runs the length of the car on one side.

At a signal from the guard, the engine gives a little toot from a tiny whistle that sounds to an American like a child's penny affair, and the train pulls quickly and smoothly out of the station. Hampered by little weight, it is under way and at full speed in a surprisingly short time. Over the well-nigh perfect roadbed it whirls at a high rate of speed, which it maintains well into the heart of even so great a city as London.

The door of the compartment is now swung open by a guard, and a number of porters appear as if by magic, ready to carry baggage and assist with information. If speed and safety of transportation are the primary aims of a railroad, the English roads are superior.

The Midland and Great Western systems run through the heart of England. Although it has a total trackage of 2285 miles, the longest continuous run is but 320 miles. The road owes its origin to the rivalry between the Leicestershire and Derbyshire coal fields, and it is in most respects the great pioneer railroad of England, upon which most improvements have been tested out and practice established. It is associated with the names of George Stephenson, the inventor of the locomotive, and George Hudson, the "railway king" of England. The opening of the first section of the line in 1832 was an event of importance, heralded by bell ringings and huge dinners. On this road the first excursions were organized, and the afterward famous Thomas Cook began his "world tour" system by purchasing transportation at wholesale rates from the Midland and organizing party trips. The road was the prime mover in building the great Forth Bridge.

CAIRO TO THE CAPE

THE man who took decisive steps toward making the "Cape to Cairo" railway a reality was that great empire builder, Cecil Rhodes. The work of establishing a metal highway from one end of Africa to the other is a stupendous task. The first African railway was begun in 1859 between Capetown and Wellington, a distance of fifty-eight miles. The discovery of diamonds in Griqualand West in 1867 caused an extension to Worcester

through very difficult country where steep grades and sharp curves are the rule. In 1885 the first train steamed into Kimberley, and in 1890 the road was extended to Vryburg.

Mr. Rhodes now entered the scene. He added Rhodesia to the British possessions and strained every nerve to traverse the new country with a line that should form an important link in the great chain. After vainly seeking aid from the English government, he started the Rhodesia Railways Company for the purpose of driving a line through Mafeking to the Zambesi. The British South Africa Company advanced the money and, as Bechuanaland is easy country to forge through, the railway advanced very fast. By June, 1895, Gaberones was reached, and on November 4, 1897, a decorated locomotive arrived in Bulawayo, 1360 miles from Capetown.

To the northeast the line stretches an additional 250 miles to Salisbury, where it joins the track running southeast to Beira on the Portuguese coast. Another track runs northwest from Bulawayo to the Wankie coal fields en route to the magnificent Victoria Falls. From the Zambesi the rail is destined to pass through northeastern Rhodesia, rich in minerals and rubber, to the southern end of Lake Tanganyika. From this point the route is a matter of discussion. Some urge making use of the string of great lakes, joining them by short lines and so attaining the Nile, which would float the traveler and his merchandise down to Khartoum, where he may take his choice of river or rail.

The Uganda Railway covers a distance of 580 miles. It extends from the island of Mombasa to Port Florence on the Victoria Nyanza. Surveys for the line were begun in 1891, and ten years later the first locomotive reached the lake, which is now two and one half days' journey from the coast. Over the old caravan route the time was seventy days.

For fifteen guineas (seventy-five dollars) one may travel from Capetown to Bulawayo in a train that will compare favorably with anything to be found in England or on the Continent. The train de luxe contains dining and sleeping cars, lounges, kitchens, lavatories, and bathrooms — in fact, all the conveniences of modern life. Doubtless in due time this important piece of continental engineering will be finished and "from Cairo to the Cape" will no longer be a phrase but a reality.

THE LOFTIEST RAILWAY IN THE WORLD

It is in Peru that one finds the loftiest railway in the world. Peru has two lines, both of which pass over the Andes. One is from Callao on the coast to Oroya on the Montana or eastern slope of the Andes; the second is from Mollendo on the Pacific to Lake Titicaca. The former is 140 miles in length, the latter 420 miles. Of these the Oroya-Lima is the more remarkable. In about 100 miles' distance it rises from sea level to an altitude of 15,665 feet, about the height of Mont Blanc.

The construction of the Oroya line was begun in 1870. The distance from Callao to Oroya is only 80 miles, but the line has a length of 140 miles on account of the multitudinous turnings and zigzags of the course. So steep is the country that in places the line runs in galleries cut in the face of precipices by men lowered from above in "boatswain's chairs." The rail crawls up the side of awful chasms, every now and then plunging into the rocks to emerge, perhaps, upon a bridge that spans the foaming Rimac, roaring hundreds of feet below.

Two of the most notable crossings are those of the Verrugas and the Infernillo. The first is cleared by a bridge 575 feet long in four spans. The bridge is supported by iron towers, the central of which is 252 feet in height. This viaduct contains 662 tons of iron, and it was put together by runaway sailors accustomed to work at considerable heights. In spite of the difficult conditions under which the work had to be carried out, the total time occupied was but forty-eight days.

At the Infernillo, where the main stream runs between two perpendicular walls of solid rock fifteen hundred feet high, the train crosses from wall to wall out of the tunnel on one side into the tunnel on the other, over a bridge above the seething waters.

The engineers and workmen encountered many dangers. Not less dreaded than the slippery cliffs was the Verrugas fever, a disease peculiar to the neighborhood of the Verrugas

stream. It was reported that in one cutting alone seven hundred died from this fever.

This Oroya Railway not only climbs higher than any other railway in the world, but it provides the only road in the world down which a man on wheels can travel for over one hundred miles by his own momentum. When one starts at the summit he is in the atmosphere of eternal snow; when he finishes his hazardous descent he is among humming birds and palms.

THE TRANS-SIBERIAN RAILWAY

The great Siberian Railway was begun in 1891 and completed in 1901. During these ten years four thousand miles of railway had been laid, a record of over a mile a day. This scheme of laying a ribbon of steel across the Asiatic continent first matured in English and American brains.

On account of the climatic conditions the engineers met with many hardships and great difficulties. While constructing the trans-Baikal section they had to blast the cuttings with dynamite, as the earth was congealed to the consistency of rock. It is so cold in this section that at the stations water-supply pipes had to be laid in culverts provided with a heating apparatus, and the masonry could be built only in artificially warmed shelters. The Ussurian Railway was driven with the greatest difficulty through virgin forests of cedar and larch intertwined with vines and creepers, and when laid the track often suffered severely from the heavy floods that occurred during the best working season. Plague wrought havoc among the beasts of burden and fever swept off many of the workmen. No less than thirty miles of bridges cross the many rivers over which the railway passes, and for hundreds of miles the track is protected from flood only by being raised on a five-foot embankment above the surrounding country.

The Russians promise that when their great line is in full working order the journey from London to Shanghai will be possible in sixteen days and at a cost of about fifty pounds. By sea the same journey costs at present nearly double this amount, and it occupies more than double the time.

The Trans-Siberian Railway will not only be a means of transit between western Europe and Japan and the north of China, but it will also be the shortest route between England and Australia. It is expected that it will eventually be possible to reach Australia from London via Siberia in twenty-two days. This great system has cost the Russians upward of one hundred million pounds, or five hundred million dollars.

THE GOVERNMENT-OWNED RAILROADS OF EUROPE

The railroads of Germany, Austria-Hungary, Belgium, Holland, Denmark, Russia, and Italy are owned and operated by their respective governments. The German government was the pioneer in this movement, assuming control of the railroads as early as 1843.

The roads are finely constructed, and many very fast trains are run, especially in the neighborhood of Berlin. Passenger fares are extremely low. The majority of the people travel in "third class" carriages, and the charge is in some instances as low as six miles for one cent. It is said that the freight service is made to suffer for this cheap and rapid passenger service. It is also to be borne in mind, in comparing the cost of railroad travel in Germany and America, that all costs, including wages, are relatively low. Only actual hand luggage to a very limited amount is carried free, and the excess charge for a traveler is sometimes greater than his fare.

The Austro-Hungarian government claims to have the most perfect railroad system in the world. Comparisons of this sort are difficult to make. There are 11,300 miles of railroad in the empire, and the cost of construction was $98,000 per mile, while in America the average cost is about $10,000 per mile. When we take into account the lower cost of labor in that country, the difference is seen to be even greater. It may be said, roughly, that the Austrian railroads cost ten times as much to build as those of the United States. The added cost arises from very solid masonry at all points where there is the slightest excuse for it. The road employs eleven men to a mile, while the average operating force on American roads is but six men to a mile. What is called the "zone

system" is in use in determining fares. That is, the traveler goes at the same price any number of miles within the zone. Budapest is the center of the zones, which are arranged in circles as nearly as possible of about twenty miles each.

Russia is a vast country. The railroads are very long and operated with much form and ceremony, but with little comfort to the traveler. Even in the bitter cold of that country in winter the poorer travelers are carried in cars that resemble an American freight car of what we call the "gondola" style; that is, a sort of open box on wheels. No seats are provided in these cars, and of course there can be no heating or other comforts. The rich travel very luxuriously, in compartment cars sumptuously upholstered. The stations are at regular distances apart, except where there are very large cities to be accommodated, and the stations are often miles away from towns.

Italy has had much trouble in the past with her railroads. The government purchased such as were already built and added to them, but for many years did not feel equal to their operation, and farmed them out to operating companies for one third of the gross receipts. The companies were little interested in the improvement of the property which they could never hope to own, and the government was mainly interested in drawing its revenue. The result was great deterioration and disorder. At one time a car of dynamite was reported to be "lost," and every car of freight had to be stopped and closely scrutinized. At another time the officials of one of the operating lines wired to the St. Gothard road of Switzerland inquiring if they had seen anything of twenty locomotives which they had lost. Finally, the government was compelled either to take over the operation of the roads or sell them to the companies. It was decided to undertake their operation, and since that time there has been much progress.

The railroads of Belgium are often mentioned as the best examples of government-managed railroads. They are said to yield a high profit at a very low cost of service. The country is level and offers no engineering difficulties, while the population is very large and the traffic heavy. Owing to careful though expensive overseeing, accidents are practically unknown.

THE RAILROADS OF TO-DAY AND WHAT THEY HAVE DONE

As we have followed the progress of the railroad from its uncertain and modest beginnings, so let us now take a view of the present and a look into the future.

It has not been the effect of any one great improvement that has made the railroad what it is to-day, but the combination of a vast number of small events taking place from time to time. One of the transcontinental trains stands in the station waiting to convey with an almost genii-like swiftness its human freight across three thousand miles of mountains, valleys, and plains, and at the same time to keep these passengers as comfortable as though they were enjoying life in one of New York's most sumptuous hotels. Let us make a careful inspection of this moving van of luxury and see what it includes.

A MODERN TRAIN

As we pause by the great locomotive, we see the engineer with his long-nosed oil can and torch peering in at the running gear and giving the last feed to the oil cups. The fireman in the cab, with the fire door wide open, is covering the fire with fresh coal so that the boiler will be in the proper condition to make steam rapidly when the time for starting comes. As we look at this gigantic mass of iron and steel and hear it hissing softly, as if to make us aware of its tremendous power, we realize what enormous strides have been made in its development since Stephenson's *Rocket* made its appearance in 1829.

The engine before us weighs perhaps one hundred tons and is able to pull a load of possibly three hundred and fifty tons at a speed of fifty miles an hour. The engineer, sitting comfortably in his cab, is able by means of the various valves and levers within his reach to control to the finest degree the 1500 to 2000 horse power which the engine is capable of developing. The smokestack is short, as the steam coming from the engine cylinders passes up the stack and provides the proper draft. On the side of the boiler is the small air pump, puffing away to fill the pipes

and reservoirs of the air-brake system with air. If it happens to be after dark when the starting time comes, a brilliant searchlight appears at the front in place of the kerosene lamp formerly used.

Locomotives built for hauling freight trains are heavier and more powerful than those for passenger service. Some of them weigh from two to three hundred tons and will haul a freight train weighing as much as four thousand tons. The large locomotives for both passenger and freight service generally have compound engines; that is, the steam passes from one cylinder to another before escaping up the stack in order to make the most of its expansive power. In order to make the long trips across the uninhabited Western prairies possible, the tender is made capable of carrying ten tons of coal and eight thousand gallons of water. The largest and most imposing type of locomotive to-day is what is called the "articulated compound," which is really two locomotives as far as everything but the furnace is concerned. The engineer, instead of being stationed at the rear end with the fireman, has his cab in the middle, so that half of his locomotive is behind him and half ahead.

A TWO-ENGINE FREIGHT TRAIN WITH A HEAVY LOAD

If we happen to be in the Grand Central Terminal in New York City, watching trains enter and depart, we shall note that all trains are drawn by powerful electric locomotives. This type is daily becoming more common, especially for use in large cities where the smoke problem is important.

As we walk back alongside of the train we find behind the locomotive an express car in which the goods under the care of the express companies are carried. This is arranged with a large safe for the valuables, money, etc., and

with sleeping accommodations for the clerks who must accompany it.

Next comes the mail car, or railway post office, in which a number of clerks are busily engaged in sorting the mail for the different stations. On the side of this car is a curious-appearing device which looks like a horizontal bar supported by a bracket, so that it may either lie back against the car or be swung out at right angles. At some stations where the train does not stop and where mail must be collected the mail bag is so suspended by the side of the track that this bar will snatch the bag while the train is moving at a high speed.

Following the mail car are one or more baggage cars, into which trunks and other personal property are being tumbled at a reckless speed. As we stand watching, a truck piled high with baggage comes rolling up, propelled by invisible power and guided by a man standing on a small front platform. On examination we see that an electric motor driven from a storage battery is thus doing work which it formerly took two or three men a longer time to accomplish.

Entering the next car, we find it is a colonist coach with seats arranged so that they may be changed into sleeping bunks at night, and with various neat contrivances arranged for the comfort of the emigrants bound for the Western country. We pass through two or three of these cars and come to the Pullman coaches, sleeping cars, dining saloons, observation cars, etc., which make up the luxurious major part of the train. These cars are all fitted with silk curtains, thick carpets, delicate carvings, and beautiful decorations. The parlor cars have comfortable revolving armchairs with soft, rich cushions. A smoking room and a lavatory are attached. The sleeper, which by day is an easy-riding car with high-back cushioned seats, may at night be quickly transformed into a long passageway with a number of curtained apartments, each containing two comfortable upper and lower berths. At the ends of these cars are one or more "staterooms," which are small, isolated rooms fitted up as finely as those of any high-class hotel. Lavatories are also provided at the ends of the car.

The dining saloon is a restaurant with kitchens complete, where one may enjoy a meal equal to that served anywhere. The observation car at the rear of the train is so arranged that passengers may get the full benefit of the wonderful scenery which our country possesses, enjoying it either from the inside of the car or from the broad platform at the rear. Among the many appointments of modern trains like this may be mentioned the barber shop, library and reading room, bathrooms, public stenographer, wireless telegraph, and railway telephone. A corps of trained servants is in attendance.

Surely if those responsible for the beginning of the railroad were to ride on such a train they would imagine they had been suddenly introduced into a tale of the Arabian Nights.

FOOD SUPPLY AND THE FREIGHT TRAIN

The way in which the population of the world has increased in the last fifty years and the manner in which it is now congested in the large cities make the railroad an absolute necessity for the rapid transportation of food supplies. Were it not for the fact that the immense farms and ranches in the Far West can in an incredibly short space of time transfer their products to the Eastern cities, where the bulk of our population is found, we should find ourselves in a starving condition. It is the railroad which makes this transfer possible. The long, snakelike freight trains, with their refrigerator cars for perishable goods, their cars for live-stock transportation, and their special cars for numberless kinds of raw material and manufactured goods, which may be seen daily traversing our country from one end to the other in every direction, form a very great and very important part of the railroad life of to-day.

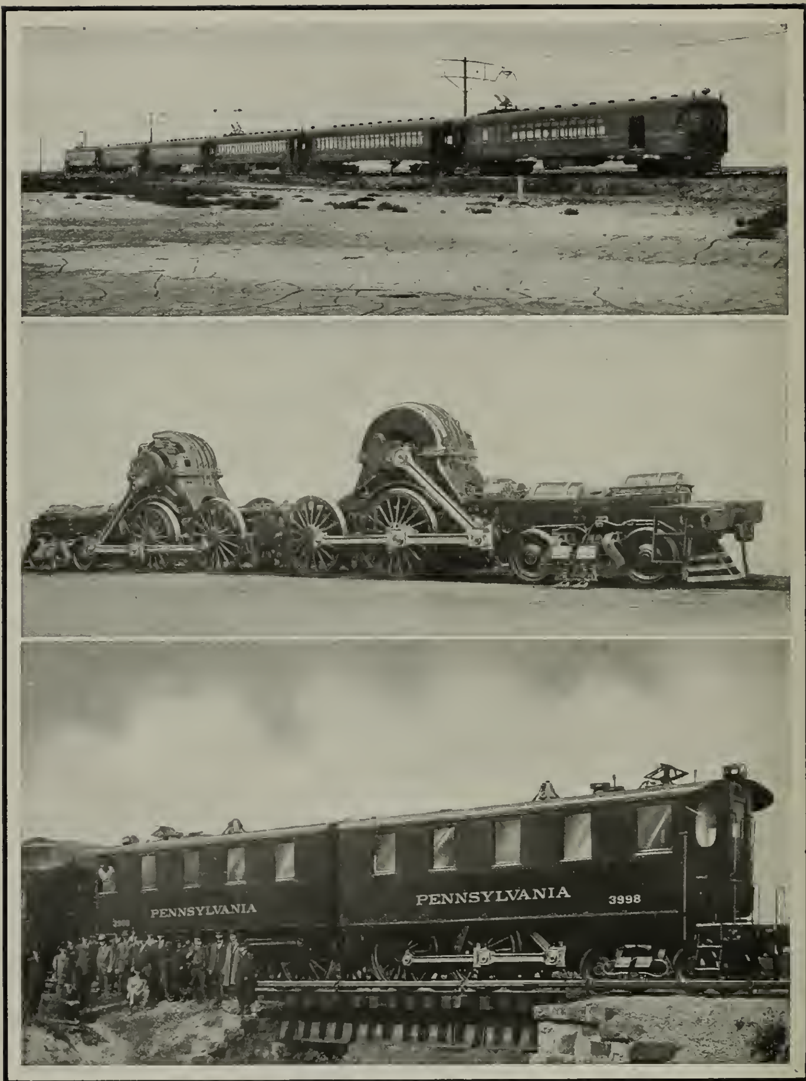
DEVICES FOR SAFETY

It is extremely gratifying when traveling in a railroad train to be able to feel that, though we may be dashing through the country at the rate of fifty miles an hour, every provision possible has been made for our safe conduct, and that many ingenious and wonderful devices are working toward this end.

Electricity has played no small part in this great work; compressed air also enters to some

THE MAIL CAR OR RAILWAY POST OFFICE

Top: Making a flying throw and catch of mail. One arrow points to a pouch thrown from the car; the other to a pouch which is entering the car door at the same instant. Bottom: Clerks within sorting the mail.



Courtesy of Pennsylvania R. R.

ELECTRIC TRAINS AND LOCOMOTIVES

Top: A modern electric train of the Southern Pacific Railway on a suburban passenger line. Middle: Chassis of electric locomotive of the Pennsylvania Railroad, designed for New York tunnels. Bottom: Type of electric locomotive used in Pennsylvania tunnels.

extent. These railroad signals, by which the engineer must be guided in running his train, have been partially described in Volume II. There are various systems of signals and switches, and the subject as a whole is rather complex. Suffice it to say that the different systems have been so perfected and so many safety devices are being added each year that the chance of an accident becomes more and more remote. Another great factor of safety possessed by every train is the air brake, also described in Volume II. If a sudden danger looms up ahead, instead of the engineer's signaling by whistle for the brakes and the two or three brakemen on the train running to the end of the car and applying the brakes by hand — the whole operation taking, perhaps, one or more minutes and then, perhaps on account of lack of men, not all the brakes being applied — the train of to-day, twenty cars long and running twenty miles an hour, may be stopped within one hundred feet by the almost instant application of the compressed-air brakes on every car. This invention of George Westinghouse's has done more toward bringing his name into public honor than anything else he has done. Another improvement which is continually being made to increase not only the safety of those using the railroads, but of the public in general, is the abolition of grade crossings. In the course of a year many lives are lost at points where a railroad crosses a highway. The most dangerous of these, particularly in the center of cities and towns, are being done away with as fast as money can be raised for the purpose.

Courtesy of Pennsylvania R. R.

A MODERN RAILROAD STATION, SHOWING THE ARRANGEMENT OF TRACKS TO AVOID CROSSINGS AT GRADE

WHEN ACCIDENTS OCCUR

Yet, in spite of all care and precaution, accidents will occur; mechanical contrivances will break down and the human mind will make mistakes. Taking into account the number of trains moving and the number of passengers carried, the percentage of accidents is very, very small. Many do occur, however, in the course of a year, and it is interesting to note the provisions made for taking care of them.

The wrecking train is a combination of ambulance, fire engine, and emergency wagon. At certain important points on the road one of these trains is always stationed, and kept in readiness for instant departure and use. There is generally a hospital car with one or more physicians in attendance and every appliance for handling emergency accident cases; there is the coach in which the specially trained crew of men ride; there is the tool car where every tool which could possibly be needed is laid out ready for instant use; and finally, the flat car with the crane capable of lifting from fifteen to twenty tons. The crew of this train are so well taught that not a movement is wasted and every man knows just what to do. To save human life is, of course, the first object. Of scarcely less importance, however, is the speedy clearing of the track so that traffic may be resumed. The thoroughness with which these crews do their work is shown by the fact that in most cases forty-eight hours after the accident occurs every trace of it has been removed.

RAILROAD ENGINEERING FEATS

We have spoken briefly of some of the great engineering feats which have been undertaken and accomplished for the sake of the railroad. Tunnels have been bored through mountains and under rivers; bridges and trestles have been constructed over seemingly impassable cañons and gorges; and the iron-horse road with its two shining rails has now penetrated to regions where not long ago it was hardly possible for man to travel on foot.

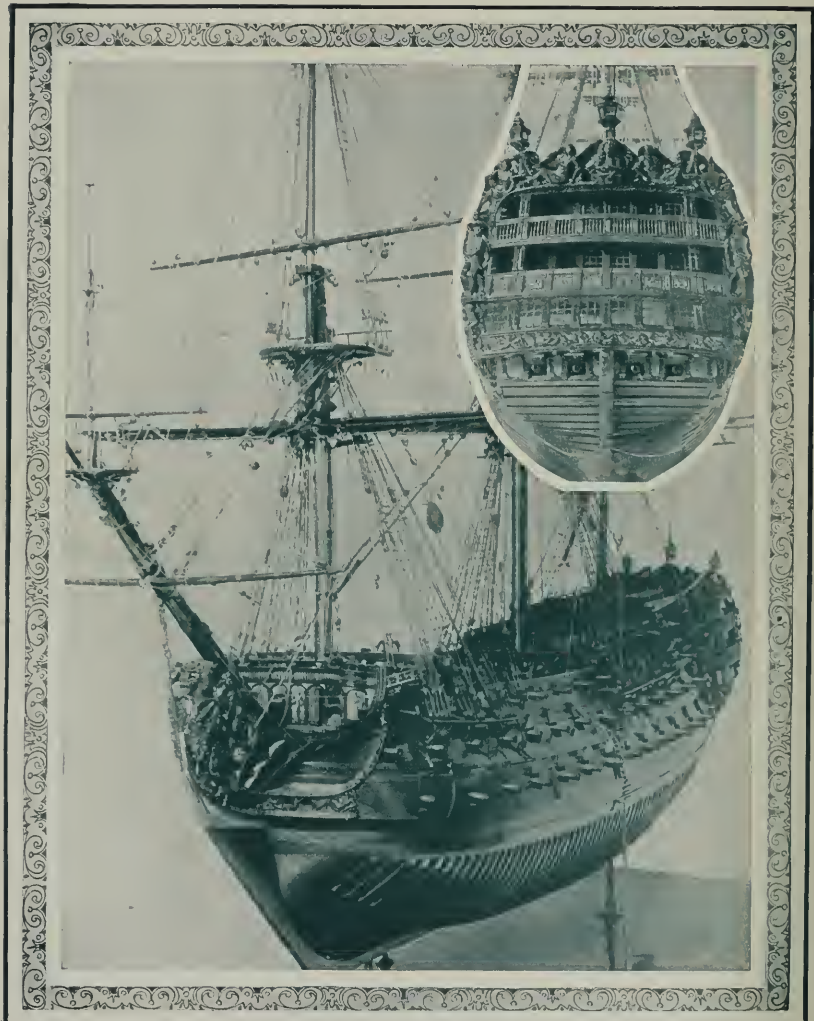
The story of the boring of the eight-mile St. Gothard Tunnel through the Alps, connecting Switzerland with Italy, is most thrilling. The building of the Siberian Railway; the extending of the road from Miami, Fla., a distance of one hundred miles, over swamps, reefs, and sea to Key West; and the fact that one can now travel through Africa by rail and water from Capetown to Cairo except for a very few miles — all are facts which tell of the achievements of our great railroad-building engineers.

In several cases, both in this country and abroad, special railroads have been constructed to the tops of mountains, some as high as fifteen thousand feet. On grades steeper than six per cent, the mere friction between the wheels and the rails is not sufficient to overcome the force of gravity and move the train, and in such cases a toothed rack is laid between the rails and the engine pushes its way up by means of a toothed gear which engages with the rack. Many of our regular railroad trains climb to heights of several thousand feet in their daily work. All of those running to the Pacific coast must pass over the mountain ranges in the western part of the country.

At these high altitudes much difficulty is found in keeping the tracks clear of snow, and every year thousands of dollars are spent in fighting this element. Not only does a severe snowstorm bury the tracks, but it breaks telegraph wires and poles and throws the whole system into disorder. To prevent discomfort and possible loss of life when trains are stalled and buried in the snow, all of the transcontinental trains carry an emergency supply of food. Fuel and food are also cached at intervals along the more dangerous parts of the line.

Another branch of railroading which might be considered at great length is the electric railway. This is now a very important factor in all civilized countries and serves to fill in the niches between the steam lines and also to compete with them successfully, especially for the suburban traffic. The cleanliness of the electric motor, as well as other advantages, makes it popular for many conditions.

It is very clear from what has been said that the progress of civilization is due in no small measure to the advance of the railroad, and those to whom the credit for this belongs are in every sense of the word benefactors of the human race.



OLD-TIME WOODEN VESSELS

These pictures show the exquisite carving and fine workmanship of the shipbuilders of the seventeenth century.

Copyright, American Press Association

BATTLESHIPS IN MID-OCEAN

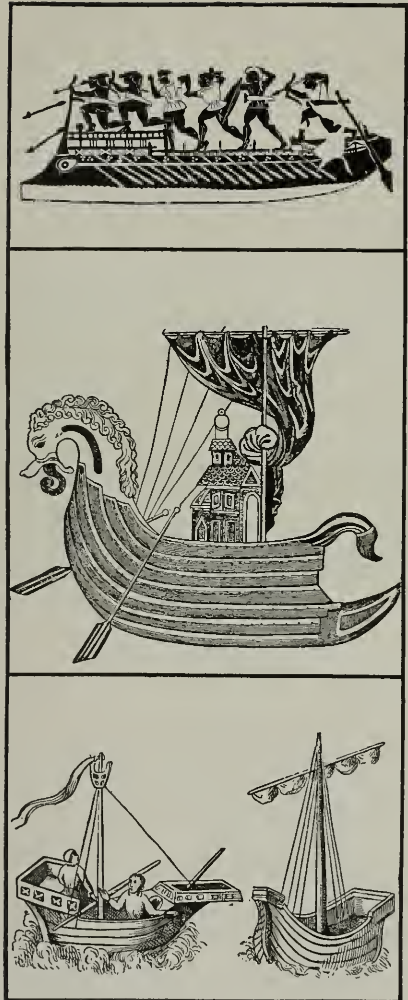
THE STORY OF SHIPS

SHIPS AND SHIPBUILDING

So many famous ships have sailed the sea and left their mark on the greatest pages of the world's history that their story is full of fascination. The peoples surrounding the Mediterranean Sea were generally good sailors. First the Phœnicians, then the Greeks, then the Carthaginians, then the Romans dominated that beautiful blue ocean. The ships of all these countries were much alike. They depended upon oars for motive power, using sails as a help when the wind was favorable. That these mariners could have had little knowledge of sailing in any direction except nearly before the wind is evident from the fact that their vessels were all flat bottomed, without keels or centerboards, and carried but a single mast, with square sails. Such a ship could not be made to sail close enough to the wind to tack to any advantage. It seems very strange that so inventive a race as the Greeks and such bold sailors as the Phœnicians should not have mastered a secret that the savages of the South Seas seem to have understood from the earliest times.

GREEK AND ROMAN SHIPS

But if these ships were clumsy sailors, they were very powerful and speedy under the great sweeping oars, manned by slaves, with which they made the most of their way. They were built as large as three hundred feet long, with two and three banks of oars, one above the other, and with two and three slaves to an oar,



ANCIENT SHIPS, FROM 600 B.C. TO 1500 A.D.

The galley at the top (redrawn from a Greek vase of 600 B.C.) shows the extreme type of vessel depending on oars for its motive power. The early Anglo-Saxon vessels below show the gradual transition to masts and sails. The wonderful carved figurehead in the middle picture was supposed to help in finding the way.

tugging with all their strength under the lash of cruel masters. The best picture you can get of this kind of life is in the story of "Ben-Hur."

These vessels were built of pine, red fir, and cedar, with oak keels and sometimes oak frames. As their builders knew nothing of bending wood by steaming (which, again, is perfectly understood by the North American Indians), they used only green timber for shipbuilding, in order that the timber might be sufficiently pliable. And great trouble they must have had afterward from warping and shrinking. They did not understand how to strengthen their frames by trusses, so that they were forced to resort to great cables stretched over props from stem to stern, to keep the ship from "hogging" or buckling up in the middle. They understood calking and used tow for that purpose, as it is used on wooden ships to-day. They also used pine tar to make the seams water tight, and painted the whole in ornamental designs.

The ships carried a very stout beak or ram, with which to fight pirates or the ships of hostile nations. Over this really dangerous weapon of offense the head of some fabulous monster was carved and painted. The eyes of this figurehead were very important, for the superstitious sailors believed that with these the ship found its way and escaped hidden rocks. No sailor would sail on a ship that did not have good eyes.

The master sat high on a throne in the stern of the vessel, and officers bearing knotted whips carried his orders to the wretched captives, of whom the crew was usually formed.

As these ships did not venture farther from shore than was necessary, sailing in the dark was very dangerous and seldom attempted. It was customary to land every evening and draw the ship partly up on shore. That many vessels should be wrecked in this manner is not so remarkable as that any should undertake a long voyage. Such voyages consisted in creeping alongshore from point to point, waiting through tedious days for favorable winds, and toiling at the oars. The story of Paul's shipwreck gives a good idea of the dangers of this kind of travel. Single ships under venturesome masters penetrated as far as from Phœnicia to the British Isles, but ordinarily few

voyages were undertaken beyond neighboring ports. A glance at the old maps in this volume shows us how little the ancients really knew of the world.

THE NORSEMEN AND THEIR SHIPS

The bold inhabitants of the stormy shores of the North Sea were far more skillful and scientific sailors than the Greeks or Romans or any other people of classical antiquity.

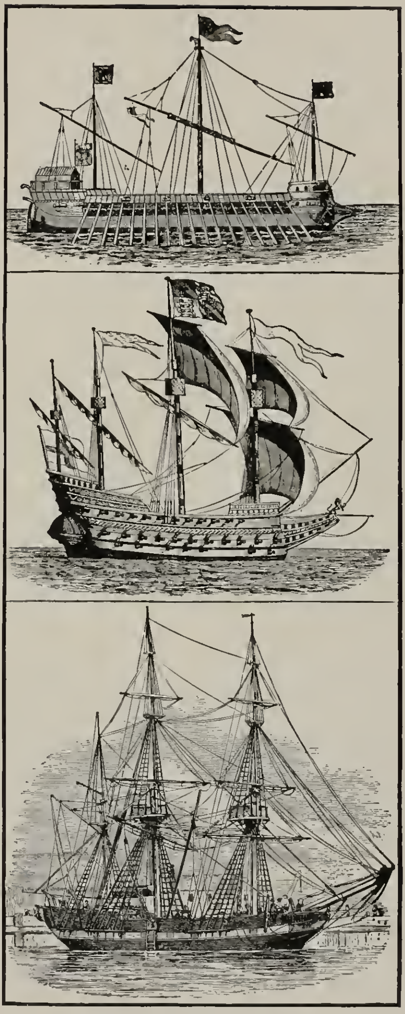
One of the old Viking ships was dug out of the sand not many years ago, and an exact copy of it was exhibited in this country. It was a round-bottomed, clinker-built, partly keeled boat of a very shapely model. The arrangement for stepping a mast was well forward of amidships. Such a vessel could be made to sail in any direction, could work into the wind by tacking, and venture without fear into heavy seas. And with these uses the Norsemen were undoubtedly familiar. Their traces are found even on this side of the great Atlantic Ocean, to cross which could never, even under the most favorable conditions, be within the power of a Roman trireme.

Undoubtedly it was from these adventurous sailors, whose marauding parties spared no civilized coast of Europe, that the seamen of the Mediterranean learned the true art of sailing, the building of ships that would hold their way without drifting across the wind, and that could be sailed in an angle toward the wind. At any rate, there is no picture or description of a ship capable of doing this until after the days of the Norsemen.

Had the commercial instincts of the Norsemen been as strong as their love of war and their ability as sailors, they would easily have remained the masters of the sea for many ages and perhaps for all time. But when they found rich lands and made new conquests, they were quite content to forsake the sea and sit down and enjoy the fruits of their victories. They cared little for trade or barter. So the mastery of the sea fell into other hands.

THE VENETIANS

The inhabitants of the strange city whose streets are of water became the next lords of



FROM GALLEY TO SAILING VESSEL

The Greek and Roman galley furnished the basis for the Venetian galleass of the top picture, a warship of the 16th century with the oars of a galley and the masts of a sailing vessel. Such a vessel as this went in the Spanish Armada to meet the English man-of-war directly below. The bottom picture is of a "free-trade" bark of the East India Company, early 19th century.

the ocean. The Venetian caravel was a seaworthy craft, capable of sailing to the remotest ports, if well manned and directed by sufficient knowledge of geography. This last was still sadly lacking, and many were the shipwrecks that paid the penalty of ignorance. As the Venetians gathered wealth by their commerce, other Mediterranean cities eagerly sought to share the rich rewards of trade. Genoa and Naples became famous for the skill and boldness of their navigators, although they added little in ship construction. As Spain was now a rising power, she too sought fame and wealth on the high seas. Her ships were called "galleons," and were imitations of Italian, especially Neapolitan, models.

Then came the great era of discovery and the rise of Holland and England to the rank of great maritime powers. Gradually England won precedence over all rivals, and has stoutly maintained it to this day. Her great victories by sea were won not only because her sailors were freemen and not slaves, not only because they were descended from the old Northmen, the best seamen the world has ever known, but also because of her great oak ships, so much more stanch than the pine and cedar structures of her rivals.

THE OLD ENGLISH MAN-OF-WAR

These great ships, to whose superiority so much of present-day history is due, are worthy of a word of special description. Nelson's famous flagship, the *Victory*, was a fine example of wooden shipbuilding. To our eyes she would seem very round and clumsy. But British practical sense had discarded the great deck houses that loaded the sterns of the Mediterranean ships. The lateen sail (a three-cornered sail with a boom at the top only) had disappeared in favor of the square sail with boom at top and bottom. Masts were much taller and sail rose above sail in a great towering mass of canvas. The amount of tackle required to handle these many sails and yards was absolutely bewildering to a landsman and required a long apprenticeship for its mastery. The hulls were built of well-seasoned oak on stout oak frames. The bottoms were sheathed with copper. The guns were placed in tiers on three decks, and numbered one hundred in all. However, a complete broadside of fifty guns would not hurl against the enemy as great a weight of metal as a single shot from a modern thirteen-inch gun. But it was terrible enough in those days, and the broadside of a British man-of-war was a synonym for the height of destructive power. It was quite sufficient to sweep from the seas all opposition but that of her own sons on this side of the Atlantic, who improved upon the shipbuilding of the motherland and added a keener marksmanship to the gunner's practice.

The close of the War of 1812 found the United States occupying a leading position on the sea, and her ships represented the height of design and construction of the old wooden sailing vessel.

THE WOODEN SAILING VESSEL AT ITS BEST

Many of the records of the old Yankee clippers are beaten only by the largest and swiftest steam vessels. The *Red Jacket*, one of the most famous of these boats, sailed her 3184-mile transatlantic course in ten days, reaching a speed of 417 knots in twenty-four hours at her best. In grace and beauty these wonderful ships have never been surpassed. Their hulls had none of the heavy clumsiness that characterized even the old English "walls of oak." They did not seek to beat their way through the sea by sheer weight and mass of canvas, as did the English style of ship which they superseded. They were as delicately outlined as the finest racing yacht of our own time, and great attention was paid to the reduction of friction. The rig also was simplified and more scientifically balanced.

The British builders were quick to follow these improvements. The clipper *Thermopyle*, of 1991 tons, left London, November 7, 1868, for a cruise around the world. She passed the *Lizard* by six the next evening, was out of the English Channel the same night, arrived off Port Philip, Melbourne, January 9, and reached Shanghai, after a run to New South Wales, in twenty-eight days. From Shanghai she returned direct to London in ninety-one days.

A fortnight later the *Sir Launcelot* did the

same journey in eighty-nine days. The *Thermopyle* was not beaten by steam vessels until the opening of the Suez Canal, when she was forced to abandon the route and became a general trader. In 1895 she was bought by the British government for use as a training ship.

SAILING VESSELS TO-DAY

Nowhere are the traditions of the old clipper days so well preserved as in the fishing fleet of the North Atlantic coast. The center of this important industry is Gloucester in Massachusetts. The Gloucester fishing schooner is one of the best designed, best built, speediest, and stanchest boats that sails the sea. In these little vessels the hardy mariners not only brave the dangerous Newfoundland shoals, but penetrate far into the arctic circle, passing the winter among icebergs and floes. They cross the ocean to catch the mackerel on the Irish coast, and indeed venture anywhere that profit leads and boats can go. The Gloucester schooner is a graceful vessel with two or three tall masts, rigged with topmasts, and a long bowsprit. The schooner rig discards the square sail of the full-rigged ship and employs the handier sail of the fore-and-aft type; that is, a sail that is fastened to the mast by hoops along its forward edge, or "luff," as it is called in sailor language. To balance these large surfaces of canvas, head-sails are used in the same manner as with a full-rigged ship. Under full rig the Gloucester schooner carries a mainsail and main-topsail, a foresail and fore-topsail, a staysail, jib, and flying jib. Occasionally a fourth headsail is added.

THE "RED JACKET," ONE OF THE MOST FAMOUS YANKEE CLIPPERS

This vessel crossed the ocean in ten days.

The ship is steered from the wheel placed near the stern, and so handy is the rig that in fair weather it is usual to leave her to be maneuvered by the captain and cook alone, while the crew are out in dories fishing. A crew

of five men can take such a vessel around the world. The schooner will sail much closer to the wind than the full-rigged ship, and is much speedier on all tacks that head into the wind.

The quickness with which she can be handled and her canvas raised, reefed, or lowered is marvelous. For the work for which she is made, she surpasses the square-rigged vessel as much as a modern ocean liner surpasses the old clipper. But on long voyages, where the steady trade winds allow the sails to remain set, almost without trimming, for days at a time, the square-rigged vessel is faster. In sailing before the wind the square rig is superior to the fore-and-aft rig of the schooner type.

MODERN FREIGHT SCHOONERS

In spite of the greater steadiness and power of the square rig on long voyages where the trade winds blow, the schooner type of vessel is now an active competitor of the full-rigged ship. The reason for this is that the rig is more economical and easier to handle. A crew of half the size required by a ship can handle a schooner of the same tonnage with ease. Consequently we sometimes see schooners built with six and seven masts. On these huge carriers the sails are raised by machinery. A crew of eight or nine men is carried for a ship that is four times as large as the old-time square riggers, which would have required four times as many skilled seamen. Often the captain and mate are the only men on a freight schooner who have any knowledge of the sea.

SQUARE RIGGERS

A few square-rigged vessels, mostly brigantines — that is, vessels equipped with both square and fore-and-aft sails — are still used. They may be seen in the trade between the United States and the Mediterranean ports. They also are found in the Argentine trade, carrying lumber out and hides home. Wherever the trade-wind belts are sailed, the square rig will manifest its superiority.

It is pleasant to know that they have a sure place in the commerce of the world, and are not likely to be entirely superseded. No more beautiful object is built by man than a full-rigged ship, seen under sail in a brisk breeze. Her vast weight seems to bound to the slightest ripple and to answer the lightest touch of the helmsman's hand. She seems like a thing of life, rather than a machine.

THE TRANSITION TO MODERN SHIPBUILDING

Two great advances in the industrial world have brought about the changes that have so altered the appearance of our ports and the trade of the seaman. These are the introduction of iron and steel for structural purposes and the use of steam for power.

In the days of the wooden vessel, iron was too expensive to be used for heavy structural work, but improvements in processes of smelting have so reduced its cost that, considering its strength, it is cheaper than wood for many purposes. Another reason is that with equal strength it is the lighter material and thus better adapted for shipbuilding than wood. It is doubtful if sufficient rigidity of frame for modern high-powered engines could be secured by the use of wood. At any rate, for most purposes no one thinks now of building wooden vessels. Steel is cheaper and better.

The use of steam for the propulsion of ships dates from the *Clermont*, built by Robert Fulton and used successfully between New York and Albany on the Hudson River. So great was her success that both in America and abroad she soon had many imitators. These were all confined to river traffic or to inland waters, until the *Rob Roy*, a ninety-ton vessel of thirty horse power, was built for the Dover-Calais service across the English Channel.

Not long after this came the world-famous American ship, *Savannah*, the first steam vessel that ventured to cross the ocean. It was in 1819 that the *Savannah* made her first memorable voyage. She was a ship of 350 tons and her engines were credited with ninety horse power. Her voyage was remarkable rather as overcoming a prejudice than as a record performance for steam. She required thirty days for the trip, a time far below that of the swift packets of the clipper type, and used her sails much more than her engines. Indeed, her fuel was exhausted long before she reached

THE "LEVIATHAN," A STEAM VESSEL OF THE TRANSITION PERIOD

Here is a combination of square rig, fore-and-aft or schooner rig, and steam power. The two larger masts are square rigged, having square sails spread on yards running across the masts. The other five masts have the fore-and-aft rig; that is, the sails are mounted on long spars or booms and swing from the mast by hoops, which can be seen in the picture.

THE "CLERMONT," ROBERT FULTON'S STEAMBOAT

The speed attained by the "Clermont" in the first trip to Albany, August 11, 1807, was only five miles an hour, but her voyage revolutionized shipping.

the other side. Her paddle wheels were small and were so built that they could be detached and taken on board.

It was not until the really remarkable performance of the *Great Western*, a ship built by the Great Western Railway of England, that steam may be said to have established its superiority on the sea. The *Great Western* was a wooden vessel, built in 1838. She made the trip in twelve days, the time of slow steamers to this day, carrying 152 passengers. She was a financial success, thus giving a great stimulus to the steamship business. The founding of the Cunard Line followed, and modern shipbuilding began.

JOHN ERICSSON AND THE SCREW PROPELLER

It is doubtful if steam navigation could have gone far if it were not for the invention of the screw propeller to replace the cumbersome paddle wheel. The inventor of this great improvement was John Ericsson, a Swedish engineer, born in 1803, a direct descendant of Leif Ericsson, the Norse voyager. As early as 1838 Ericsson constructed an iron screw steamer, the *Robert F. Stockton*, which crossed the Atlantic and was used on the Delaware River as a towboat. In 1841 he was induced to come to America, where he designed the naval vessel *Princeton*, a screw propeller with its machinery all below the water line. The *Princeton* had so many improvements that she became the model for the world. In 1861 Ericsson designed and built the famous *Monitor* to fight the armor-plated Confederate ship *Merrimac*. Her success revolutionized the construction of warships, for the *Monitor* was a turreted, armor-clad ship, and the forerunner of all modern war vessels.

The superiority of the screw propeller was demonstrated by the British government in an experiment that attracted great interest. Her Majesty's Ship *Rattler*, 888 tons, fitted with engines of 200 horse power, was attached by a cable to H. M. S. *Alecto*, a paddle-wheel steamer of about the same power. On a quiet day in April, 1845, the two vessels got up steam, and at a given signal throttles were thrown open and a tug of war was started, the results of which were to make another revolution in shipbuilding. In a few moments the *Rattler* was towing the *Alecto* all over the harbor, stern foremost, at a perceptible speed. An

TWO OF MAN'S GREATEST ACHIEVEMENTS — THE OCEAN LINER AND THE SKYSCRAPER

eyewitness says: "The *Alecto's* paddles were revolving and churning the foam like a whale in a flurry, while a slight ripple under the *Rattler's* stern alone showed that there was power at work. The *Alecto*, in spite of frantic efforts, was dragged slowly astern, and the era of the screw had begun."

It should be noted, however, that at the present day both England and America are using paddle-wheel boats of twenty-two to twenty-five knots for coast transport.

RECENT IMPROVEMENTS

Improvement in recent years has been chiefly of size, speed, and detail rather than structure. Certain of the advances made are still under trial, such as the use of oil as fuel and of the turbine. The turbine is a wheel with curved blades against which the steam is forced. It is fastened directly to the shaft, and as it has a continuous motion with unbroken application of power, it is capable of higher speed than can be obtained from a reciprocating engine of the old style. The weaknesses that have not yet been overcome and which have prevented its universal adoption are the increased amount of fuel burned, the fact that it will not move backward, and its liability to derangement. Most modern liners that seek speed are equipped with turbines, but do not depend upon them alone.

THE RACE FOR SIZE

The first hint of the mammoth size that would later characterize the transatlantic liner came with the building of the *Great Eastern*. This ship was launched in 1858, and until 1905 was still the largest vessel that had ever been

Courtesy of Fore River Ship Building Corporation

STERN VIEW OF AN OCEAN LINER IN DRY DOCK

built. She was of 27,380 tons' displacement, nearly twice as large as the average liner of to-day. Her construction was attended by many mishaps and the financial ruin of the company which undertook the enterprise. For a long time it was found impossible to launch her. In speed she was a great disappointment. This fact and the general suspicion that she was unsafe and "unlucky" kept her from being a financial success. Many of the ideas used in the construction of the *Great Eastern*, however, are now embodied in all of the great liners.

She proved her safety and structural strength, and as a steamboat was as great a success as she was a financial failure. She had iron bulkheads, a double skin with three feet between the inner and outer plates, and was built on the cellular principle. She once ran against a hidden rock and tore a hole in her outer skin nearly as long as the boat, but was able to make port without difficulty. The only distinguished use to which she was ever put was the laying of the first transatlantic cable. This feat alone will number her always among the historic ships of the world. She was sold again and again and finally used as a coal barge.

THE FIRST MODERN LINERS

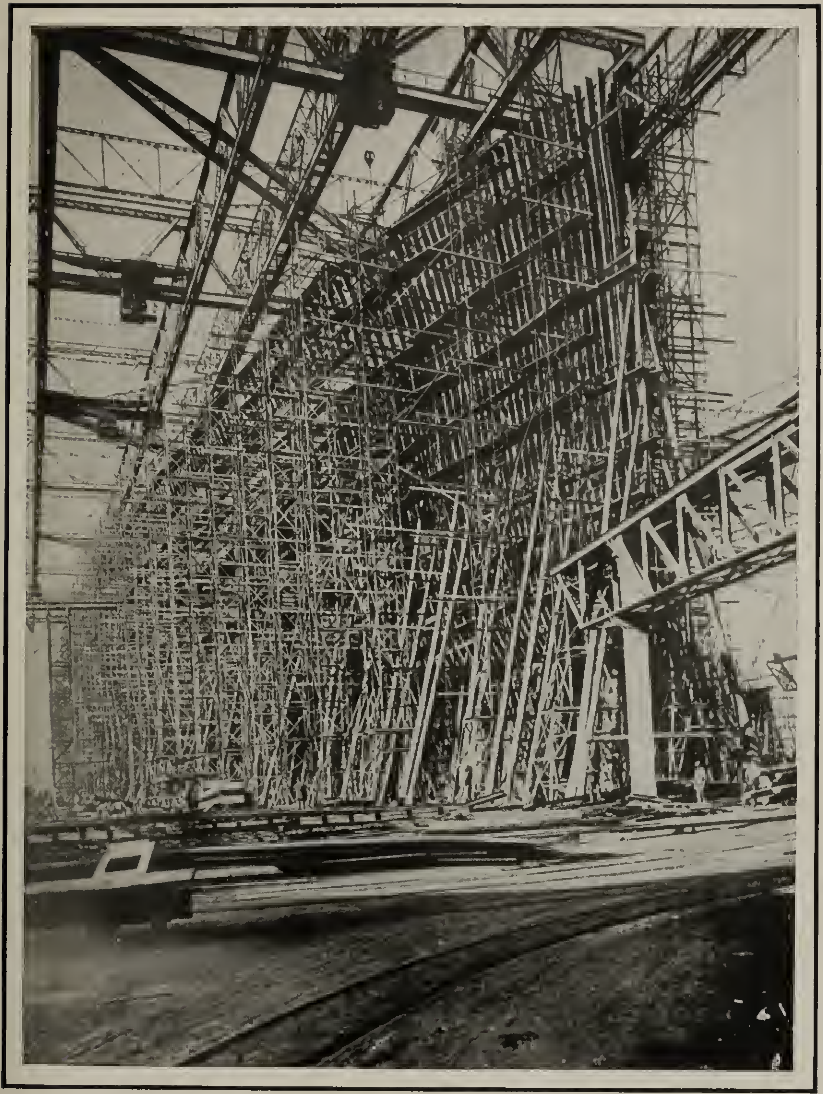
The *City of Paris* and the *City of New York* (now called the *New York*) were the first ships to embody the features that distinguish the modern liner: size, speed, twin screws, division of passengers by classes, huge superstructure with many decks, balanced by great depth of hull, and the striving after all of the luxuries possible to the most costly city life on shore. The building of these ships was quickly followed by the construction of larger and more luxurious ones by the rival lines. And the race continues along the same lines to-day. It was thought by many that the terrible disaster to the *Titanic* would put a check on this competition, but it has not seemed to do so.

SPEED LIMITATIONS

Only in the matter of time reduction has there seemed to be a reaction against the competition for the record. It is now felt that five days is the limit of speed for crossing the North Atlantic with economy and safety. Of course some new invention may put this record back as primitive. But at present builders are not striving primarily for a higher speed. The enormous amount of fuel needed to raise the speed a single knot an hour is the greatest drawback. It seems probable that the limiting size of docks and piers and channel depths will soon cause builders to give their attention to other details than size.

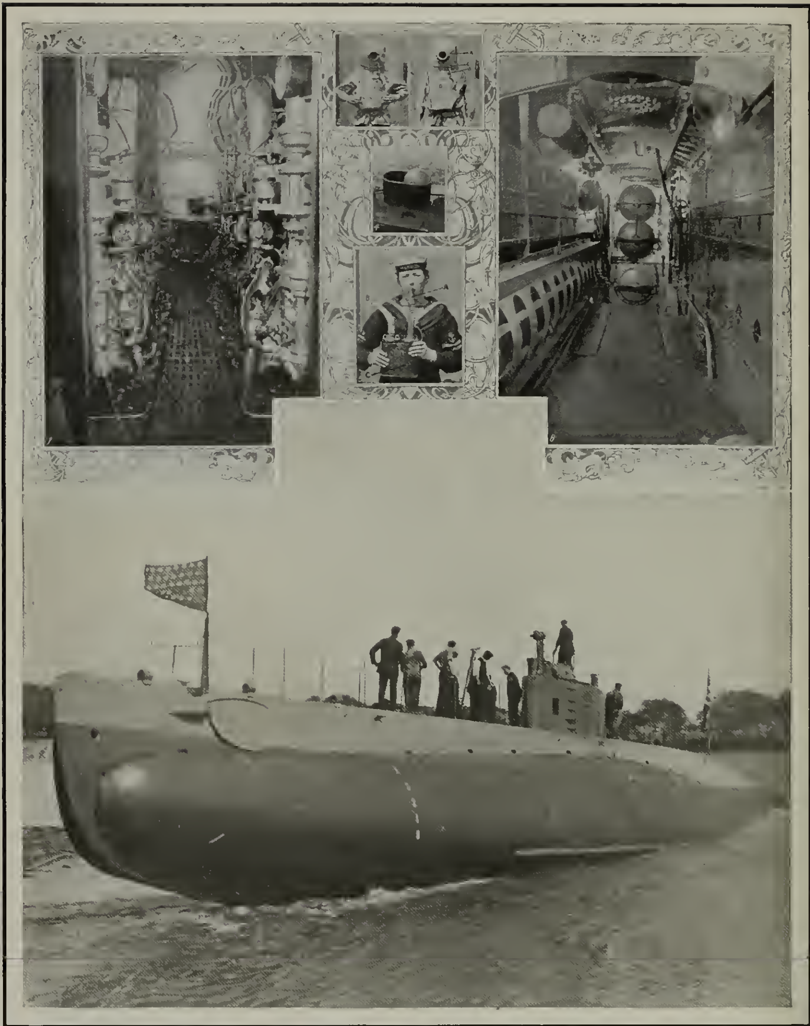
THE SPACE BETWEEN THE OUTER AND INNER HULLS OF ONE OF THE GREAT LINERS

This space is calculated to add to the vessel's buoyancy, and also its safety. If the outer hull were pierced in a collision, the water would not flood the vessel unless the wall on the right were broken through.



Copyright, Underwood & Underwood

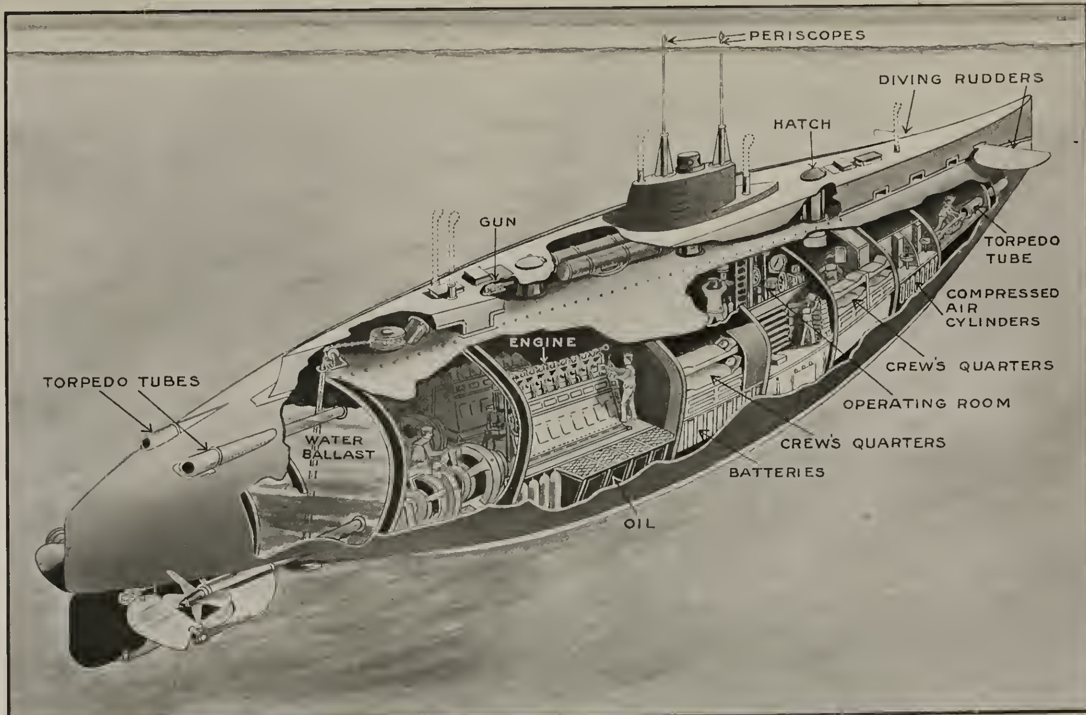
THE MASSIVE FRAMEWORK OF A GREAT OCEAN LINER, WHOSE HEIGHT EXCEEDS THAT OF A TEN-STORY BUILDING, IN PROCESS OF CONSTRUCTION



A SUBMARINE TORPEDO BOAT

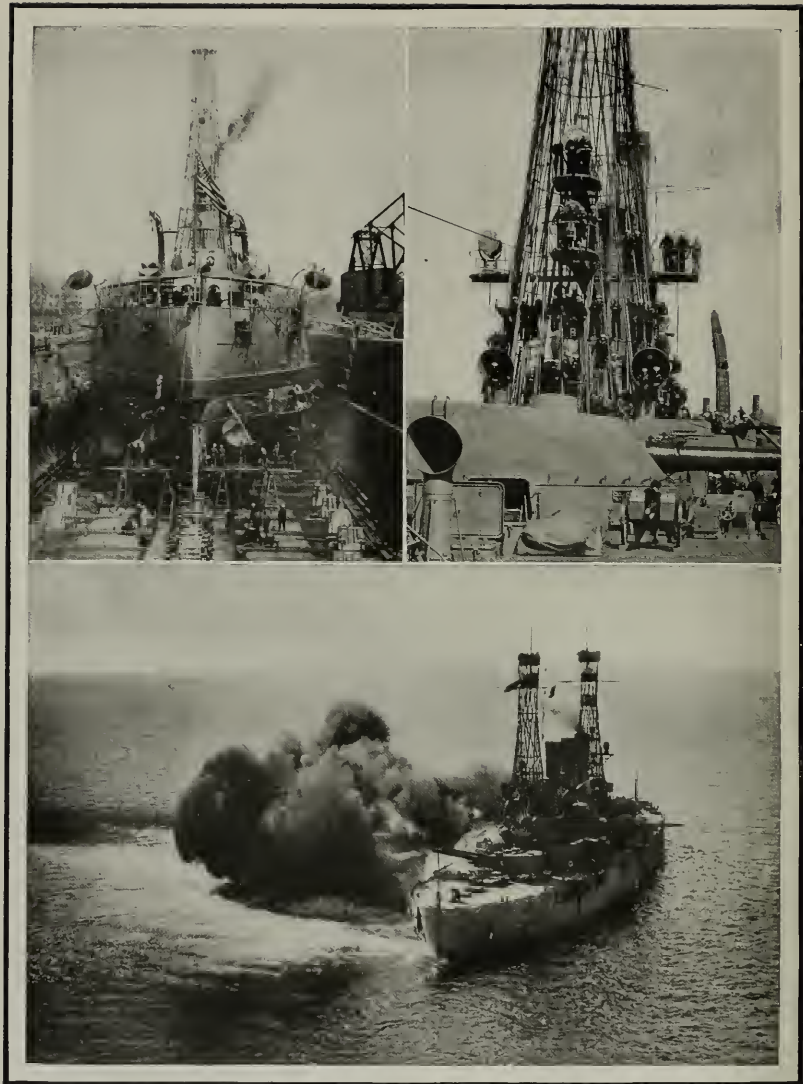
Top: 1. Motor room. 2, 3. Safety helmet and jacket, in which enough oxygen is contained to sustain life for one and one fourth hours. 4. Hollow ball designed to rise from a sunken submarine and mark its location. 5. A part of the safety helmet, the oxylithe container and purifier. 6. Torpedo room and sleeping quarters. Bottom: The launching of a submarine. (By courtesy of Fore River Ship Building Corporation.)

INSIDE A SUBMARINE



THE WONDERFUL ECONOMY OF SPACE

A submarine for war service has one purpose, to send out torpedoes, miniatures of itself, loaded with deadly explosives. Hence the torpedo tubes for discharging torpedoes. The torpedoes must go straight to the mark; hence the periscopes (see Volume II, page 157). Living quarters, engine, ballast, diving bow, etc., take only the minimum of space for efficiency.



Copyright, Underwood & Underwood

TOP: THE U. S. S. "VIRGINIA" IN DRY DOCK; MEMBERS OF THE NEW YORK NAVAL RESERVE OFF ON THEIR ANNUAL CRUISE. BOTTOM: THE BATTLESHIP "NEW HAMPSHIRE" FIRING A BROADSIDE FROM HER PORT BATTERIES

Note that the recoil of these tremendous guns has apparently no effect on the equilibrium of the ship.

THE MODERN BATTLESHIP

THE rapid development of the modern battleship began about the middle of the nineteenth century when steam was introduced as a means of propulsion for large ships. It is true that previous to this steam had been used in small paddle-wheel steamers, but this type of vessel was unsuited to much fighting, because the paddle wheels could not be well protected. The introduction of the screw propeller about this period, however, made the adaptation of steam well suited for battleships, though there was at first considerable opposition to its use. Naval men were of the opinion that there would be great danger from explosion of the boilers and from fire, due to sparks from the funnels. Also, at this time, marine engines were large and heavy, and used a large amount of coal, thus limiting the speed and radius of action of the ship.

Iron was not introduced into warship building until about 1860, and even then only reluctantly, the reason being that previous experiments in firing iron shot against iron ship plates had resulted in complete breaking up of the shot and plating, causing great damage from splinters. This failure of ordinary iron ships' plating to withstand projectiles, and also the fact that the newly invented explosive shell caused such tremendous damage to wooden ships of war, led to the adoption of iron armor for warships at about the same time that iron was first used in ships for structural purposes.

"ARMORED FLOATING BATTERIES"

Iron armor was first used in warships in the Crimean War. The French built what were then called "armored floating batteries." These were small ships of about fifteen hundred tons, carrying sixteen guns, and armored with 4½ inches of wrought iron on their sides. These batteries proved very efficient, and apart from a few shells and splinters entering the portholes, the armor kept out the shot from the Russian forts.

The first armored seagoing battleship was *La Gloire*, built by the French in 1859. This vessel was really a wooden ship, but the sides were protected by a belt of 4½ inches of wrought-iron armor. The first British armored seagoing battleship was the *Warrior*, built in 1860. This ship was built of iron, and also had armor 4½ inches thick, but the arrangement of armor differed from that in *La Gloire* considerably. In the *Warrior* the armor covered only the battery, the magazines, and the machinery and boiler spaces, the armor protection being looked upon mainly as a means of shielding the men working the guns, and for protecting the vital parts of the ship. By reason of this smaller weight of armor the *Warrior* was about one and a half knots faster than *La Gloire*. Both ships were propelled by steam power, and in addition had great sail power. In the United States the *New Ironsides* was built in 1862, and this ship was protected by four inches of armor. In the attack on Fort Sumter the *New Iron-*

sides was hit sixty or seventy times, but suffered little damage.

THE ADOPTION OF THE TURRET

In these ships and those immediately following, the guns were mounted on the broadside, as in the old wooden ships, this arrangement being thought the best for a seagoing battleship. A little later it was thought advisable to place some of the guns so as to enable the ship to fire ahead or astern. This claim was difficult to satisfy as long as the ships had masts and rigging, and so the guns for bow and stern fire were placed at the corners of an armored box, a so-called citadel or "casemate." This was an improvement on the old broadside arrangement, as the ship could fire all around the horizon with her different guns. The ideal arrangement, however, was one which would permit any gun to fire in any direction, and this was first achieved by the type of warship called the "monitor." Here the guns were mounted in a closed, cylindrical, armored structure called a "turret," which could be rotated on its axis, carrying the guns with it, and thus enabling them to shoot in any direction whatever. This type of ship had at first a low freeboard; in fact, the deck was within a foot or two of the water's edge. Consequently they were not at all suited for going to sea. They were very wet, the guns were mounted too low for shooting at sea, the speed was low, and the living quarters were too restricted. It appeared possible, nevertheless, to endow the monitor with better seagoing qualities and still keep its valuable characteristics.

Closed turrets for seagoing battleships were first adopted about 1864. The great weight of the turrets and their guns had to be placed much higher above the water than in the monitor type, and this fact soon caused the abandonment of sail power. The reason for this was that the ships would be too top-heavy when masts, sails, and rigging were carried. With the abandoning of sail power the large arc of fire for the guns afforded by the turret was obtained.

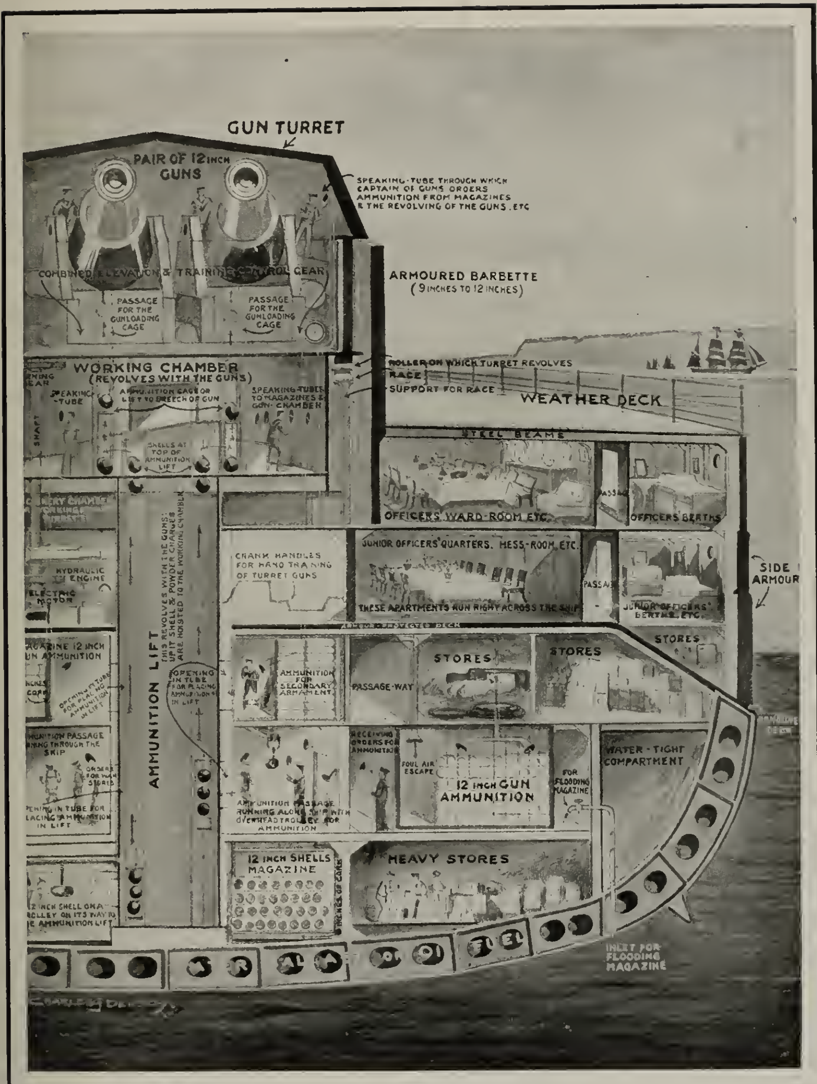
Before the complete adoption of the closed turret by all navies, a type of battleship called the "barbette" ship was introduced. The barbette was a stationary armored cylinder, open at the top, with the gun (or guns) mounted on a turntable inside, and so arranged as to be fired over the top of the barbette. This installation was preferred to the closed turret, as it did not require such a great weight high above water for the protection of the gun, thus increasing the stability of the ship and also permitting more weight of armor for the main belt.

Later, a necessity for a greater protection from small rapid-fire guns than that afforded by a barbette with an open top led to the adoption in all navies of the closed turret. The barbette is still retained in modern battleships as a protection for the elaborate turning mechanism of the turret, the roller track and its supports, and the ammunition-hoisting arrangements.

THE MODERN TURRET AND ITS BATTERY

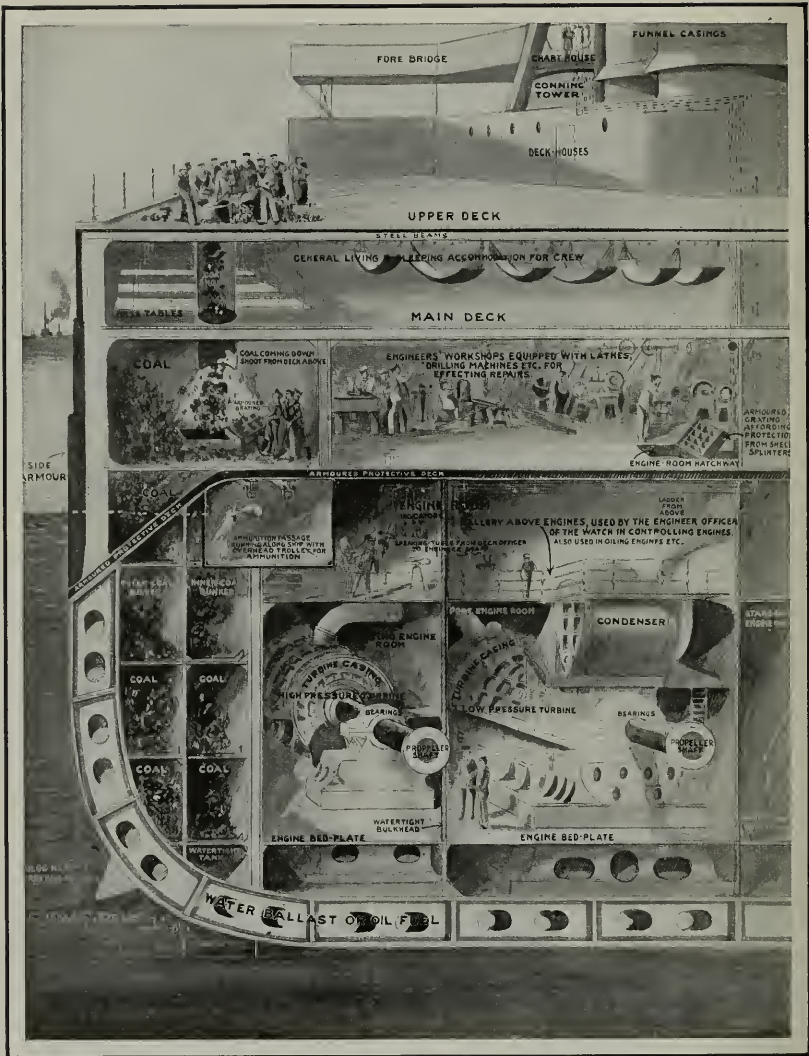
The turret is a completely inclosed structure, protected by heavy armor plates, and mounted on rollers so that it can be rotated on its axis like a turntable. The track on which it rolls is supported by a heavy steel structure extending down into the ship and supported in turn by the decks. Hoods with sighting holes are placed at the sides and middle of the turret so that the trainer and gun pointers can see the target and aim the guns. The guns are very long; for example, the length of a twelve-inch gun is about fifty feet, extending to a considerable distance in front of the turret. This makes it necessary to carry the body of the turret well to the rear of the axis of rotation so as to provide room for loading the guns, and also to balance the turret so that it rests evenly on all the rollers. Modern turrets are turned either by electric or by hydraulic power. The plates through which the guns project are made of very heavy armor, and also are inclined so as to deflect projectiles.

In the United States navy superposed turrets have been used on two classes of battleships, viz., the *Kearsarge* and *Kentucky*, and the *Virginia* class. A smaller turret having two eight-inch guns is placed directly over the large turret and turns with it, thus obtaining for the eight-inch guns a well-protected base and ammunition supply together with a commanding position. The disadvantages of this arrangement



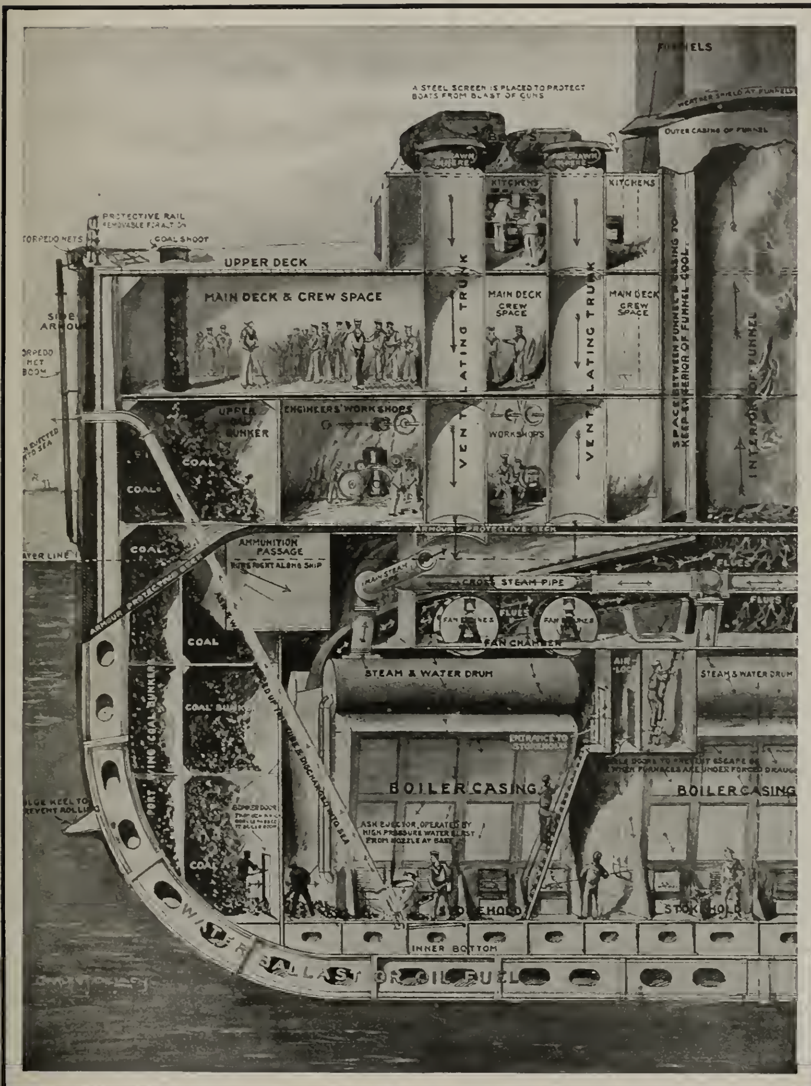
THE INTERIOR OF A BATTLESHIP: THE GUN SECTION

In this series of drawings the interior of a battleship is shown as it would be seen if cross sections could be laid open.



THE ENGINE SECTION OF A BATTLESHIP

This is the power section of the vessel, with its high and low pressure turbines and coal bunkers.



THE BOILER SECTION

This corresponds to the engine section on the opposite page.

are that the independent action of the eight-inch guns is impossible, and there is a chance of all four guns being put out of action by a mishap to the turret. Also the high position of the eight-inch turret is liable to make the ship top-heavy.

Previous to 1905 the battery for large seagoing battleships consisted of a number of different sizes of guns. For their largest guns, only two turrets were carried, one forward and one aft, and both on the center line of the ship. Smaller turrets with one or two somewhat smaller guns were sometimes placed at the sides of the ship, and, in general, the rest of the battery, consisting of rapid-fire guns, was placed behind armor along the ship's sides. These latter guns were separated from each other by transverse armored partitions, called "splinter bulkheads," so that the damage caused by a shell bursting between decks would be limited in extent.

With the advent of the British battleship *Dreadnought* in 1905, this battery arrangement was abandoned, and instead of a number of guns of mixed sizes, more of the big guns were added, and placed in turrets at different parts of the ship. This arrangement is typical of the modern all-big-gun battleship, or Dreadnought, now found in all of the principal navies of the world.

The battleship *Dreadnought* has five turrets, each carrying two twelve-inch guns. Three of the turrets are on the center line of the ship, and the other two are placed opposite each other at the sides of the ship. This arrangement of turrets has not been adopted by the United States navy in its all-big-gun ships. Instead, all the turrets are placed on the center line, some of them being placed on a higher level than the others so that the guns in them can fire over the tops of the lower turrets.

This arrangement has proved so satisfactory that it has been adopted by nearly all navies. It gives the maximum arc of fire for the guns, and also allows a convenient internal arrangement of the battleship. The turrets on the latest United States ships are to carry three guns instead of two, as formerly, and the French are even now building two battleships which have quadruple turrets. A number of small guns for repelling torpedo-boat attacks are also used, but, in general, these are not placed behind armor.

THE ARMOR OF THE BATTLESHIP

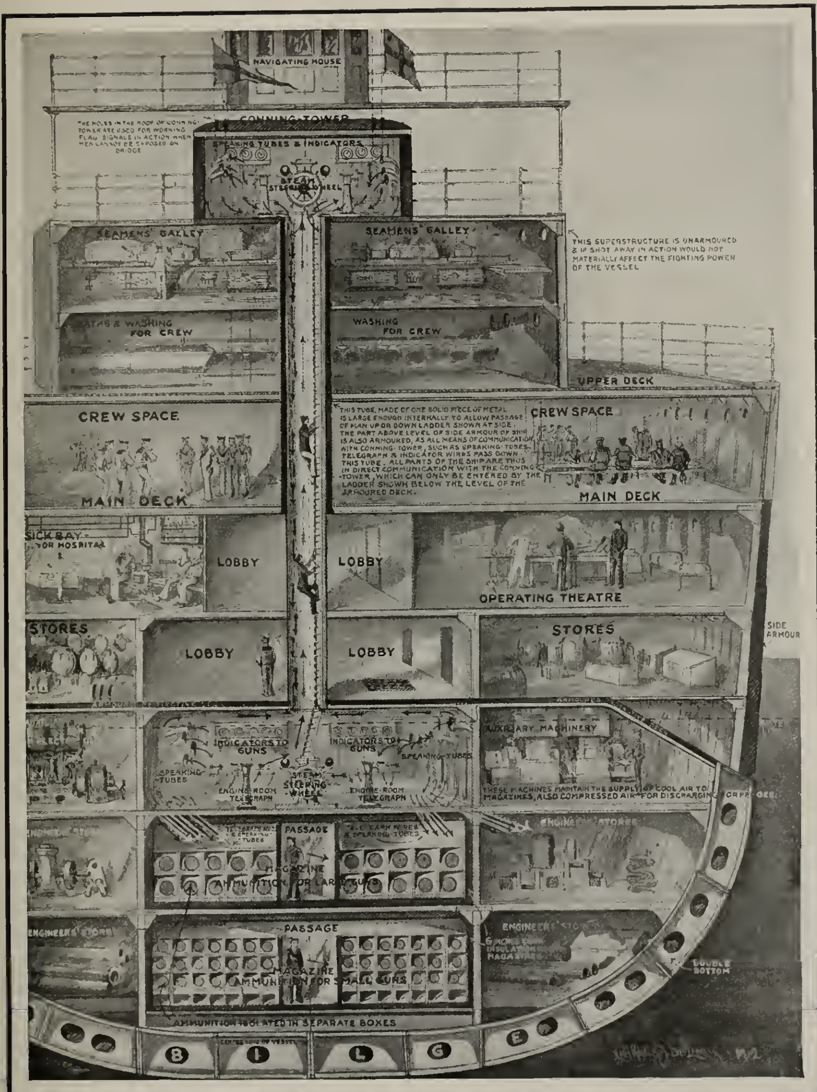
Besides the armored protection given to the turrets and barbettes, the battleship of to-day is protected by a heavy belt of thick armor extending over the whole or a part of the length of the ship, and so located as to be partly above and partly below the water line. This armor not only protects the machinery, boilers, and magazines, but preserves the stability of the ship. If the ship were badly damaged at the water line, not only would water tend to enter and sink her, but the ship might capsize through the loss in stability. Most battleships have also a secondary belt of armor called the "casemate" armor. This is placed above the main belt and affords protection for the smaller guns.

To prevent penetration into the vitals of the ship by projectiles and splinters from above, an armored deck called the "protective" deck is fitted. The middle part of this deck is somewhat above the water line, and the sides either extend horizontally to the top of the main armor belt, or slope downward at an angle of about forty-five degrees to the lower edge of the armor belt. Some battleships have two armored decks, one of them then being called the "splinter" deck.

OTHER SAFETY EQUIPMENT

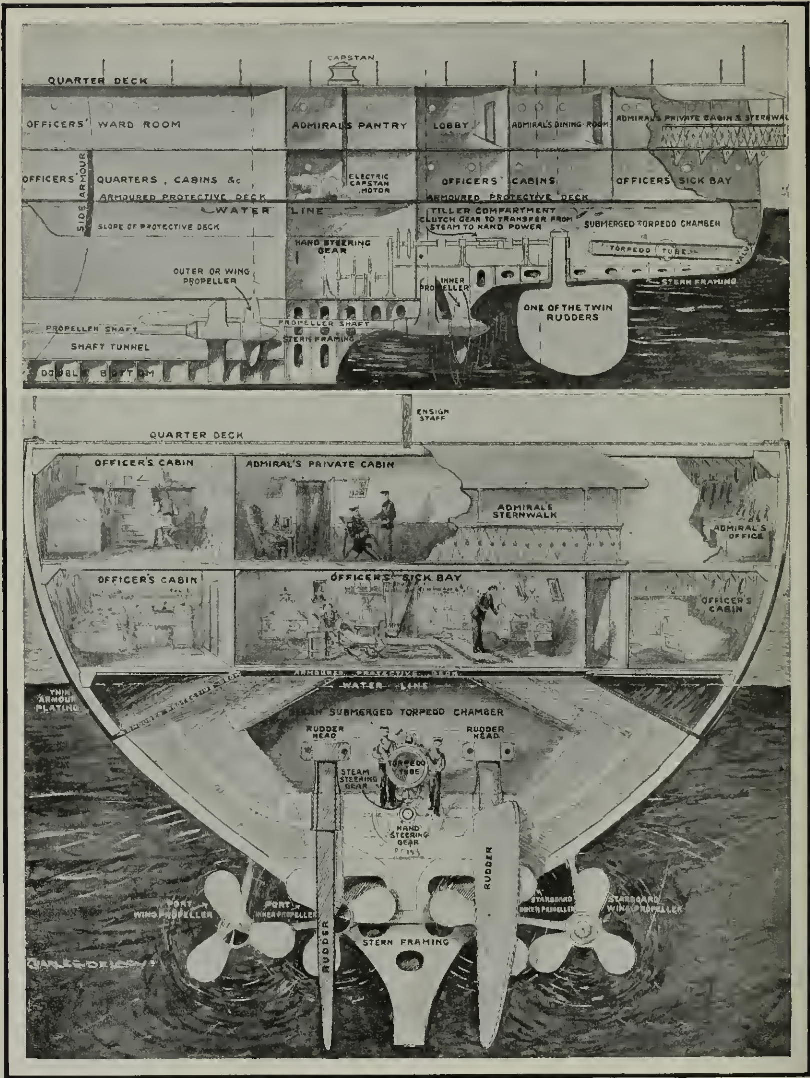
In addition to the protection afforded by armor, the safety of a battleship is further increased by an elaborate system of watertight partitions, or bulkheads, which divide the ship into a large number of compartments, several of which might be flooded at the same time without causing the loss of the ship. It is also customary in battleships that carry coal for fuel to place the coal bunkers behind the armor so as to give still further protection to the boilers and machinery. In addition to this, a cofferdam is fitted behind the main armor belt. This is frequently packed with some such material as cork or corn pith, so that if a shot penetrates the armor the entering water causes the substance to swell and thus close the hole.

Protection against attack from torpedoes and



FORWARD SECTION OF A BATTLESHIP, SHOWING CONNING TOWER

The conning tower is an armored pilot house. It contains means of communication with all parts of the ship, and is intended to protect the commanding officer and the helmsman in battle.



THE STERN SECTION

These cross sections of the stern, the longitudinal above and transverse below, show the officers' quarters, the submerged torpedo chamber, and the steering gear.

submarine mines is afforded by the complicated system of subdivision. Most battleships now have also some form of underwater armor, either external or internal.

THE DEVELOPMENT OF ARMOR

The armor used on battleships has passed through a rapid development. At first a single layer, 4½ inches thick, made of wrought-iron plates, was used. This was strengthened by an oak backing eighteen to twenty-four inches thick. Then came the "sandwich" system of armor in which the iron plates were arranged in two layers with wood in between. In 1876 steel was first used for armor, but as an ordinary steel plate had more tendency to crack under impact than iron, "compound" armor was invented. Compound armor consisted of a steel face plate welded to a wrought-iron back. The hard steel served to break up the projectile, and the iron supported and strengthened the steel. Nickel steel armor appeared about 1890, and proved much better than ordinary steel; but the greatest step in armor development was the invention of Harveyized armor, named after the inventor. This process consists of face-hardening a nickel steel plate by means of carbon, thus securing a very hard face combined with a comparatively soft back.

In 1895 Krupp invented a still more effective method of face-hardening steel plates, and this kind of armor is now used on nearly all modern battleships. The details of the process are secret, but the method is so efficient that Krupp armor offers about two and one half times as much resistance as wrought iron and about twice as much as ordinary steel.

MODERN GUNS

The guns used in battleships have passed through a remarkable development in the last fifty years. In England the rifled muzzle-loader using cast-iron spherical projectiles was the standard gun from 1855 to 1875, but in the United States smooth-bore muzzle-loaders were used during the Civil War and for some time afterward. The first breech-loading gun was introduced about 1864, and although not adopted at once, has been steadily perfected until the modern breech-loading rifled gun of twelve to fifteen inches' caliber is capable of piercing eleven or twelve inches of Krupp armor at a distance of five or six miles.

FIRE-CONTROL AND CONNING TOWERS

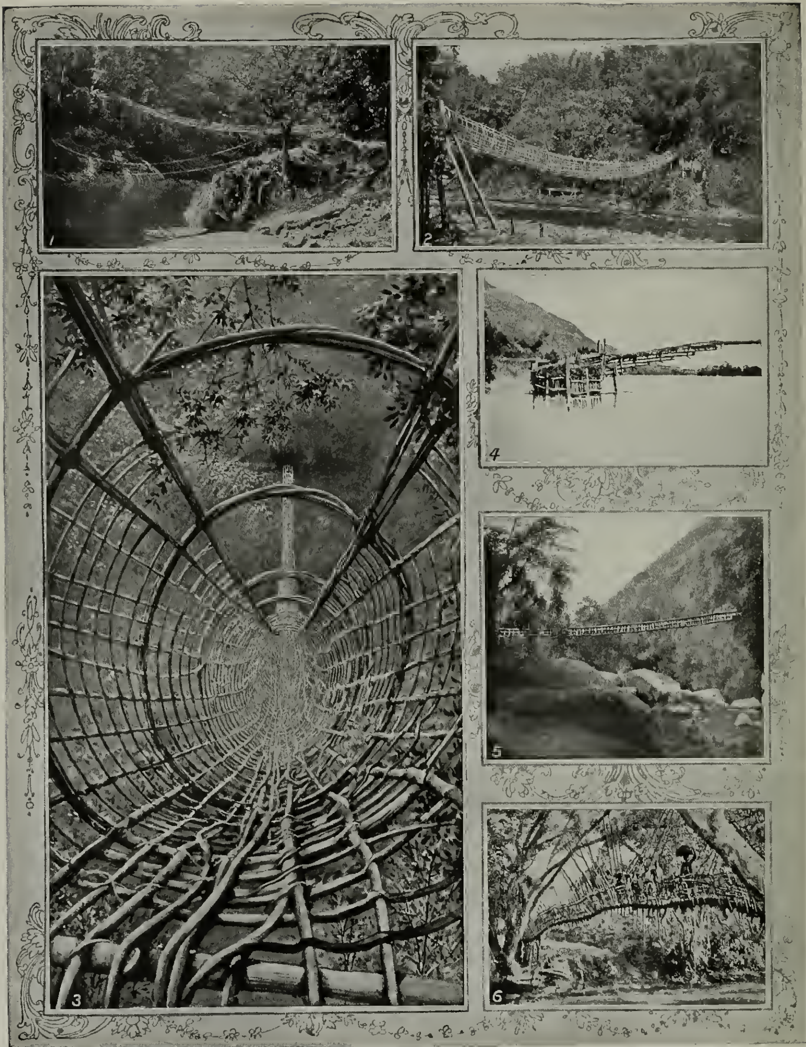
A most interesting feature of a modern battleship is the fire-control towers. In the United States navy these are the "cage" or "basket" masts. They are built of steel tubes three or four inches in diameter woven together like a basket. The idea of such a construction is that one shot or even several shots can strike such a mast without causing it to fall. In the top of the fire-control towers are the range finders (by means of which the distance of the enemy can be accurately measured) and the spotters' stations. The spotter can estimate, by reason of long experience, how far a shot strikes away from the target, so that for the next shot the aiming of the gun can be slightly corrected. The modern fire-control tower has superseded the old military mast with its fighting tops, for the reason that fighting between battleships would now occur only at great ranges.

The conning tower of a battleship is in reality an armored pilot house. It is used by the commanding officer to direct the ship when in action, and contains a steering wheel and the various communication instruments.

TORPEDO EQUIPMENT

The torpedo is a weapon much dreaded in naval warfare, and at present is an instrument of remarkable precision and destruction. It is discharged from a tube by compressed air and starts toward the enemy at a speed of forty knots through the water. It is propelled by a small steam turbine and steers itself automatically. A charge of about five hundred pounds of guncotton is carried, and this explodes on contact with any obstruction, causing tremendous damage. Torpedo nets are sometimes used to keep torpedoes away from ships.

Taken all in all, a modern battleship is a marvel of engineering, and the considerable cost and the long time to build are not to be wondered at when the complexity of its guns, machinery, and mechanical equipment are taken into account.



PRIMITIVE BRIDGES

Bridges built by natives in the interior of Africa. Figure 6 is a crude attempt at a cantilever, while the rest are of the suspension type. In Figure 3 we are starting across the bridge of Figure 2. Compare this with civilized man's efforts as worked out in the Brooklyn Bridge.

Copyright, Underwood & Underwood

THE BROOKLYN BRIDGE

This structure, built by Roebling across the East River in 1883, was the first of New York's great bridges, and a pioneer in the world's work along this line. It is of the suspension type. The volume of traffic carried by it is enormous even for the present time. The engineer of this great work died while the hridge was still unfinished, but his plans were successfully carried through to completion by members of his family who had been associated with him in his labors.

BRIDGES AND BRIDGE BUILDING

THE bridge is a striking evidence of man's progress in applying knowledge to his needs. Anyone can appreciate something of the command over mathematics and materials that is necessary to span a river at one bound with a web that seems hardly able to support its own weight. In reality the problems involved in building a bridge, though complex and difficult, are not more so than in building a tunnel or a dam or a skyscraper. With these, however, it needs the eye of an engineer to understand the difficulties. The tunnel runs under a hill or river, the dam is so huge that it seems only to require the heaping up of material, the outside covering of a tall building hides the complicated skeleton of steel; but the bridge stands clear to the eye of everyone. It looks as much a wonder as it is.

The bridge interests us, not only because of its bold and wonderful intricacy of design, but also because there are few of us to whom it does not bring some measure of comfort, security, and convenience.

THE FIRST BRIDGES

Probably the first bridge engineering was done by monkeys, in swinging their living bridges across the streams of the jungles. Men very likely began with stepping-stones. Perhaps the first human bridge was invented by some ingenious boy, whose stride was not

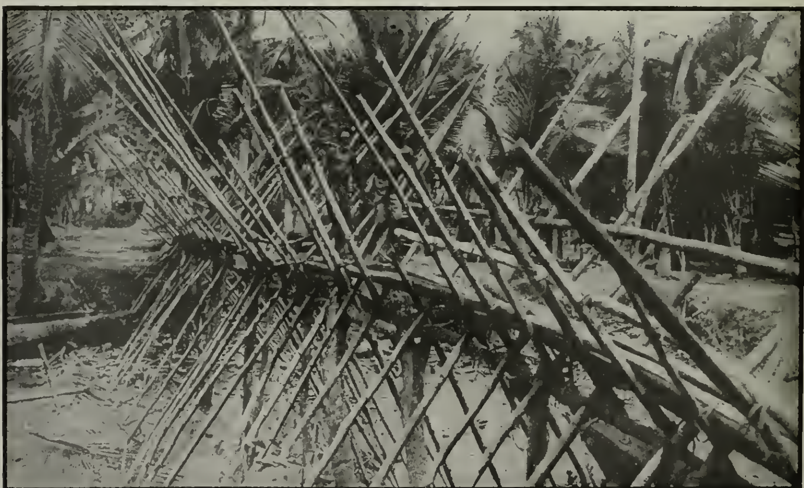
A NATURAL BRIDGE IN KENTUCKY

equal to his father's stepping-stones, and who bridged the gap with a log. When the prehistoric man saw his son's invention, he copied the idea, and felled a tree to span the whole stream, so that he and his family might cross at any stage of water.

The early beam bridges were of wood, for this was the only available material that could be worked with crude tools, and it came in large pieces. The discovery of the arch principle must have come much later, though the earliest peoples have used it. Then men found that smaller pieces of stronger material could be used, and stone entered the field as a bridge possibility. The use of metal did not begin until recent times, when chemistry and the mechanic arts had reached some degree of perfection. In bridge building, as with architecture, the influence of available material must have been considerable. Where few stones were to be found, the arch would seldom be used on account of the difficulty of carrying rock any distance, while in a country without trees, stone slabs and arches must have come into early use.

BRIDGE BUILDERS OF THE ANCIENT WORLD

The Romans were famous bridge builders. In early times they built several bridges over the Tiber, some of wood, such as the bridge that Horatius defended, and others of stone. A Roman stone arch bridge built in the first century B. C. is still in use. Cæsar built a great wooden bridge over the Rhine, as those who have read the "Commentaries" will



A PRIMITIVE BRIDGE

This is a picture of a bridge built by the natives of New Guinea in the South Sea Islands.

remember, and England has several arches dating from the Roman occupation. The early bridges of Asia were usually of wood, and were often of interesting forms. In the latter part of the twelfth century, a European religious order, called the "Brotherhood of the Bridge," began to maintain hospices at fords and ferries, and to build bridges according to more or less well-defined ideas. Their work was of profound importance, and the European bridge building of the Middle Ages was largely the result of their work or influence. One of the early great bridges was built over the Rhine at Schaffhausen in 1758, where it served its purpose until it was burned by Napoleon during one of his invasions. In America, the early bridges were built of wood up to about 1840, when iron began to enter into the construction. It was not until the seventies that the iron bridge resembling the forms which we have to-day, came into use.

Bridge building down to the last century was almost entirely a matter of faith, trial, and experience. Our present methods of scientific design have developed from the guesswork of the early builder through the "rule of thumb" ways of the later times to the exact reasoning of the present. It is interesting to see how the early tendency was to build complex structures, providing many members through which the forces could reach the supporting ends of the bridge, so that if any one piece should break, there would be other ways for the load to be carried and the bridge would not fall down. Now bridges are usually built with one system of members only, but that one system is carefully studied and made strong enough to carry the forces for any condition that is apt to occur.

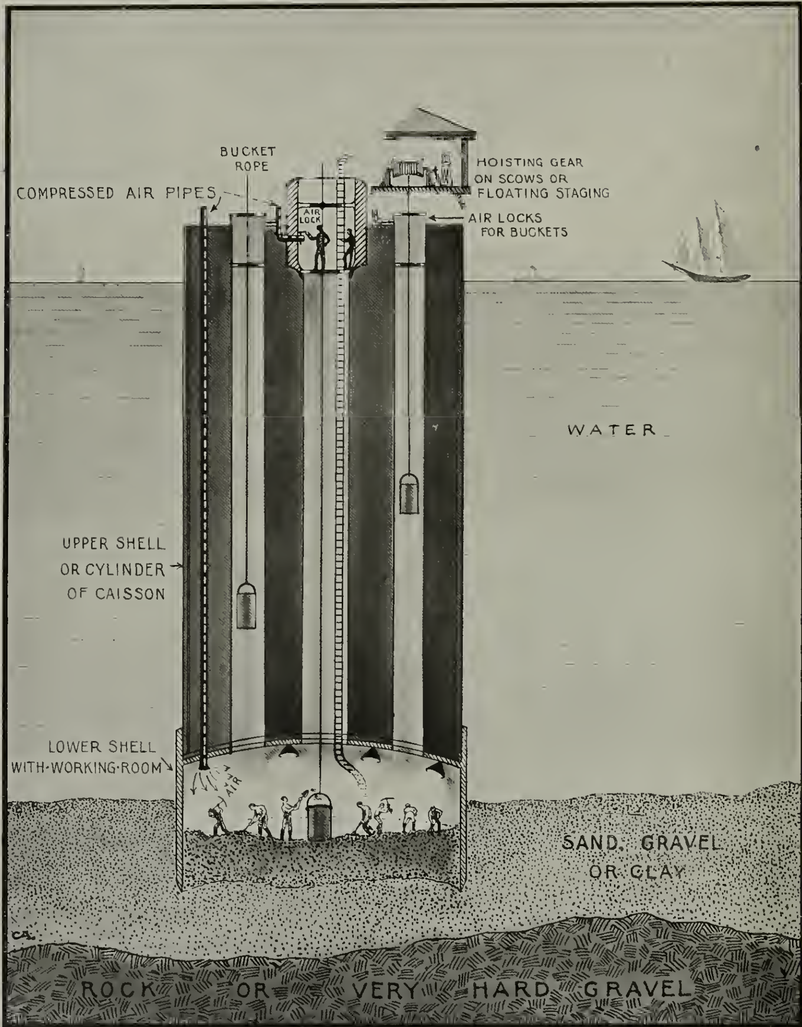
THE TWO PARTS OF EVERY BRIDGE

A bridge consists of two parts, that which spans the opening and is called the "superstructure," and that which supports the superstructure, called the "substructure." Of these, the substructure is even more important than the superstructure, just as any foundation is of more fundamental importance than what is built upon it. It is interesting to notice that the stepping-stones of our ancestors did duty as a bridge without any superstructure. Let us consider some of the problems of the substructure which make it of such vital importance. The finest bridge in the world would be worthless if the supports were likely to give way at any time, and most of this part is below the surface of the ground or water where it cannot be readily inspected or repaired. Defects in the superstructure, however, can be seen, and immediate steps taken to repair them; or if very bad, traffic can be warned away from the bridge.

WHAT IS THE SUBSTRUCTURE?

The substructure consists of the supports at the shores, called the "abutments," which carry one end of a span only, and the supports in the stream or valley, called "piers," which carry the ends of two spans. The weights which these have to carry are usually enormous, while the material on which they must be set may be anything from mud or sand to the hardest rock. Where the bridge is large, the attempt is usually made to found the piers on bed rock, though often this is covered with many feet of mud, sand, gravel, and the water of the stream. Where the rock surface is more than about one hundred feet below the water, it is usually impossible, by any methods yet devised, to carry the foundation to rock. The foundations of ordinary structures do not usually have to be carried to rock, but only deep enough to reach a firm soil. A cofferdam is commonly used in such work, consisting of a tight box of wood or steel somewhat larger than the proposed foundation, open at the ends and driven into the river bed until the top is just above water level. It may then be pumped out, exposing the bottom and allowing men to dig until a suitably hard stratum is reached, far enough below the bed so that the current may not scour the silt away from the sides and out from under the base, allowing the structure to topple over. If it is decided to found the masonry on a soft bottom, this is usually prepared by driving long logs of wood called "piles" side by side into the bed, and resting the stonework upon these. Often concrete piles are substituted for wood, and sometimes, instead of piles, a cribwork of timber is built,

HOW MEN WORK UNDER WATER



THE CAISSON IN WHICH MEN WORK UNDER TREMENDOUS PRESSURE

When work must be done under water, men go down in a strong, watertight caisson or box, fitted with an air-lock through which air is forced down in such quantities that the atmosphere is three times as dense as the natural atmosphere. Only so can men work so far under water; even with this pressure the time-shifts must be short.

large enough in area to distribute the pressure which comes upon it from the masonry. It is interesting to notice that when these wooden piles and cribs are submerged all the time, the water acts as a preservative, and no rotting takes place. Instead of wooden cofferdams, in some cases a steel shell like a boiler open at the ends is used, and the material dug out from the inside, letting the shell sink gradually with the excavation until the bottom is at the proper depth. Then the shell is filled with concrete and the superstructure rested upon it. Where a really great bridge is to be built, however, it is usually considered necessary to carry the substructure to the firm rock, whatever the difficulties. This may mean that a bridge cannot be built at a desired location, as has been the case with some of the proposed bridges across the Hudson River at New York. These deep foundations are usually driven by the caisson process, first used in America on the extremely difficult foundations of the St. Louis bridge, built by Captain Eads in 1874. The caissons reached rock 110 feet below the water, making the piers the deepest ever driven.

THE CAISSON

In this process, a tight and very strong wooden box, open at the bottom and closed at the top, and with a sharp bottom edge, is put together on shore and floated to the place in the river where the foundation is to be built. This box is called a "caisson." The top must be large enough for the masonry of the pier, which is started on it and gradually sinks it to the bottom of the stream. Air is then forced into the chamber under such a pressure that the water is driven out and men can enter through an air lock, which is a double door past which the compressed air cannot escape. They dig away the material underneath the box, and this is passed out through a specially constructed opening which also keeps the air in. As they dig, the box sinks into the river bed, pushed down by the weight of the pier masonry, which is being built up on the top. With the increasing depth of the caisson, the air pressure required to keep out the water, and under which the men have to work, becomes terrific. The shifts must be short and the labor light. Air becomes dissolved in the blood under the enormous pressure, and its expansion when the men come out is apt to produce frightful bodily disorders unless the change of pressure is very gradual. The dangers of work in the chamber are great. If the caisson strikes a soft spot, the air may blow out suddenly through this, allowing the space to fill with mud and water, and suffocating the laborers. The effects of work under the lower pressures are not bad, if proper attention is paid to the changing of pressure. The last few feet of a deep pier are proportionately much more difficult than the first, and it seems sometimes as if the difficulties were insurmountable. When rock is finally reached, the surface of the ledge is cleaned off and the chamber of the caisson filled with concrete, making a solid structure from base to superstructure.

THE DIFFERENT TYPES OF SUPERSTRUCTURE

The type of superstructure to be used for any particular bridge depends on many considerations. With difficult and costly piers, long spans would be used, for it is approximately true that for the smallest total cost of a bridge, the cost of one span of superstructure should equal the cost of one pier. The bridge should harmonize with its surroundings, hence different types would naturally be used to span a wild gorge and a city street. The height of the banks above a river, requirements as to clear passage underneath for ships, amount of money available, the difficulties of erecting the bridge, the material at hand near the site, the length of life desired, and many other things, all enter into the decision as to the type. Then, too, different sorts of loads require different sorts of bridges. A bridge to carry a canal across a river would be unlike a railroad or highway structure in the same place.

The loads that come upon a bridge are of two sorts, the unchanging weight of the structure itself, or the "dead load" as it is termed, and the variable and moving load of the men, trains, etc., called the "live load," which the bridge is designed to carry. The weight of the bridge increases rapidly, even for small

increases of span; that is to say, if a certain bridge would carry a train weighing a thousand tons over a certain span in addition to its own dead weight, in order to carry this same train over double the span, a bridge would be required whose dead weight was much more than double the weight of the first. It is important to notice that the unsupported clear span between the piers is the feature that determines the magnitude of a bridge. A very long crossing with many piers may not be nearly as expensive or difficult as a short total length with perhaps only one great span. If the span were increased enough, a length would be reached where the bridge could support its dead weight only, evidently not a practical structure, for bridges are built that live loads may be carried over them. Under our present conditions engineers have computed that the greatest single span that it would be practical to build is about four thousand feet, more than twice the opening of any bridge in existence.

Bridge superstructures are classified principally according to the direction of their reactions at the supports, according to the material of which they are built, and according to the position of the roadway on the bridge. If the roadway is on top of the structure, we have a deck bridge; if it runs through the framework, a through bridge.

THE MATERIALS — WOOD, MASONRY, METAL

The principal materials used are wood, masonry, and metal—usually iron or steel. Each substance has its advantages and its drawbacks, and may be used with peculiar advantage under certain conditions. Wood is light and reasonably strong for its weight and size. It is easily worked, and in new regions is cheap and available. Its life is short when exposed to the elements, the danger from fire is great, and its increasing cost is gradually narrowing its use in bridges. For temporary structures, however, where the same timber may be taken down and used in another location, it has no competitor.

The masonry used may be natural stone, or concrete, which is artificial stone. In short spans, where beauty and permanence are desired, and cost does not need to be too carefully considered, masonry is usually adopted. Stone lends itself especially to use in arches; but they are apt to be costly and the materials are not everywhere available. It is necessary to build a temporary structure to support the masonry during construction, thus adding much to the first cost; but when such a bridge is complete, the expense of keeping it in repair is practically nothing.

Steel is so strong for its size that it requires comparatively light and small members. With the present knowledge of its mechanical and chemical properties, it can be obtained of uniform quality and in standard shapes and sizes. It can be worked easily, and when in the form of the completed structure is reasonably permanent if kept painted. Proper attention to such protection is absolutely necessary, for when subjected to moisture and gases, corrosion is rapid. This problem of a satisfactory paint is one of the hardest that the engineer and the chemist have to solve. In the older days of bridge building, both cast and wrought iron were used, but they have been gradually superseded by steel, until it is now the most widely used material for bridge building.

The classifications of material and position of roadway are independent of the third one, that of direction of reactions at the supports. If a bridge is so constructed that when loaded with its burden it pushes straight down on its supports, it is called a "girder" bridge. If it tends to push its supports apart, it is called an "arch." If it tries to pull the supports together, it is called a "suspension" bridge. All bridges may be divided into these three groups.

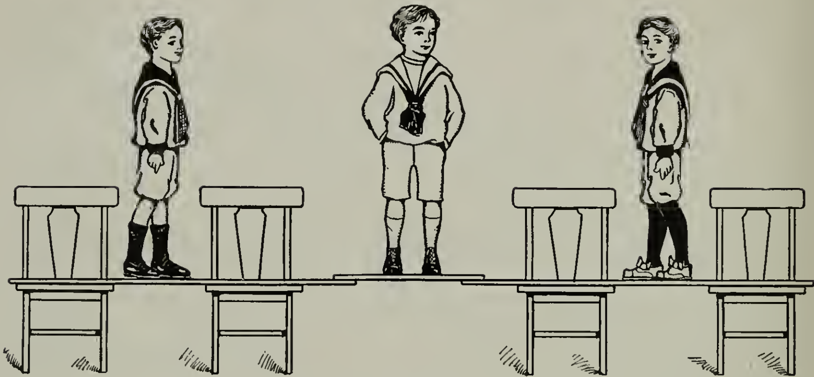
THE GIRDER BRIDGE

The girder bridge is the most familiar type. This is usually of moderate span, built of wood, steel, or reënforced concrete, either as solid beams or with some of the solid part cut away, leaving a framework called a "truss." The essential feature of the girder, however, is that the push on the supports is vertical. The plank with which the farmer spans his brook, the steel beams which support the floors of our fireproof buildings, the highway bridge that carries us over the small river, the elevated railroad structure, all are girder bridges.

Courtesy of Scientific American

THE SITTER VIADUCT, SWITZERLAND

These views were taken during the erection of the superstructure. When complete the wooden pier will be removed, leaving a single long span in place of the two now seen. Note the arch "centering" in the small spans at the ends, upon which the stone arch rings will be built up.



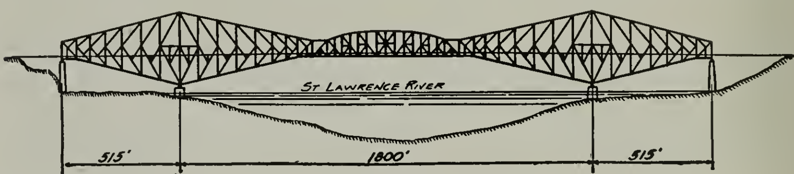
THE CANTILEVER PRINCIPLE

The safety of the boy in the middle depends on having the weight of the other boys on the end planks. The same thing might be accomplished by tying the outside ends to the chairs and the chairs to the floor. The arrangement of spans and supports is like that of the great Quebec Bridge, shown below.

By allowing the structure to overhang the supports, making projections which are called "cantilevers," the girder may appear in such great bridges as that over the Firth of Forth, shown on the opposite page, which has clear openings of 1710 feet, at one time the longest in the world.

It is easy to understand the cantilever principle by looking at the drawing of boys standing on planks. Suppose we have four chairs and three planks, and that we put a plank on each of the two pairs of chairs so that they project out toward each other over the center space. We can now rest the third plank between the projecting ends of the first two. If boys stand on the centers of the first two planks, a third boy can stand on the middle one, and nothing will tip up. If we were to tie the two end chairs to the floor and the ends of the planks to these chairs, the outside boys could jump down, and still the third boy would be supported. His safety depends on either loading the end spans enough to keep them from flying up, or on tying the ends of the planks down.

The chairs correspond to the piers of a cantilever bridge, the planks to the trusses supported, and the boys to the load the bridge must carry. This arrangement of piers and spans corresponds to that used in the great cantilever bridge over the St. Lawrence River at Quebec. Here the center opening is 1800 feet and the side spans 515 feet. The projections are to be 580 feet each, and the length of the truss corresponding to the center plank 640 feet. The center span of this great structure is up to the present time the longest in the world.



THE GREAT CANTILEVER BRIDGE AT QUEBEC

The cantilever principle in actual practice.

Copyright, Underwood & Underwood

THE FORTH BRIDGE

This great cantilever bridge had for many years the longest spans in the world. It crosses the Firth of Forth, an arm of the sea on the coast of Scotland.

Courtesy of Pennsylvania R. R.

A LONG STONE ARCH RAILROAD BRIDGE

ARCHES

Arches, the second division, are distinguished by the fact that they tend to push the supports apart. We are all familiar with such arch action in simple cases. Suppose you wish to climb a ladder resting against a wall. Before you trust yourself to it, you make sure that the bottom is in a crack in the pavement, or embedded far enough in the ground to prevent its slipping out from under you. If the bottom were on smooth ice, we know that the ladder would fall even if no one were on it. Who has not tried to make a cane stand in a corner on a hardwood floor, and had it fall down again and again, until the bottom stuck in a depression? Just as soon as the stick could push against the side of the crack, it stood up. This is the arch principle. The bottom of the structure must have not only something to rest on, but also something to push against. Suppose that two ladders are tied together by the top rounds, and a man climbs to the apex. Evidently, unless the bottoms are kept from spreading, the structure will fall. It is really an arch. Suppose that instead of ladders we have two pieces, curved like quarter circles. If now we rest the tops together, and give the bottoms something to push against, they will stand in the form of a half circle, even though the tops are not tied together. It is absolutely essential that they have something firm to push against or the structure will collapse. If now we have these two curved pieces resting together at the top and pushing against something at the bottoms, we might drive a wedge in at the top, forcing the pieces apart there, but not seriously disturbing the whole thing. We might now drive in two more wedges at the top, one on each side of the first. The sides would be spread apart more, but the whole would still stand up, and we could drive in two more wedges, one on each side of the first, spreading the structure still farther apart, but not making it fall down. If we now decrease the length of the curved pieces a little, the whole tends to go back more nearly to its original form; and if we continued to drive in wedges, but each time made the curved pieces correspondingly shorter, we might make the whole semicircle out of wedges, and still have it stand up and push against the supports at the bottoms as it did at first. This would be an arch, somewhat like those we ordinarily have. The first wedge, which still remains at the top, is called the "keystone," but it is easy to see that all the wedges are of equal importance in making the arch stand. The usual way of building one of these structures is to make a wooden form of the size and shape that the under side of the arch is to be, and then lay the wedges of stone on this form, or "center," as it is called, beginning at the bottom on each side, and working gradually up to the key-

Copyright, Underwood & Underwood

THREE NOTABLE AMERICAN BRIDGES

Left top: The Queensboro or Blackwell's Island Bridge at New York. Right top: The Eads Bridge across the Mississippi River at St. Louis, whose steel arch structure has the deepest foundations in the world. Bottom: Looking along the Brooklyn Bridge toward New York.

stone. When all the wedges are set in place, the wooden form is removed, or, as bridge builders say, the "centers are struck," and the arch supports itself. The curve of the structure and the size of the wedges depend on the weights to be carried and the distance to be spanned.

Arches are built of wood and steel, as well as of stone, and the form is well adapted to both long and short spans. Short openings are usually bridged with masonry, and long ones with steel, though recently concrete has been used for some spans up to three hundred feet. This form of bridge is well adapted to the crossing of deep gorges, where the rocky sides can resist the push of the arch, the curve of the structure rising to the roadway at the level of the neighboring country. When built of masonry they are very firm and lasting, and with proper architectural treatment may be made very beautiful. From the time of the Romans to the present, these arch bridges have been used for carrying aqueducts, because of their rigidity and permanence. Croton water is led into New York City over the Harlem River by the great stone arch viaduct called "High Bridge." The "Cabin John" arch at Washington, D. C., for many years the longest of stone bridges, carries the water artery of the national capital, and Boston's water supply crosses the Charles River by the beautiful stone arch known as "Echo Bridge." Arches of steel have been built of great lengths. The Clifton Bridge at Niagara, with a span of 840 feet, is the longest in the world, but the Pennsylvania Railroad is soon to cross Hell Gate at New York over a single steel arch span of one thousand feet.

SUSPENSION BRIDGES

The last great class of bridges has for its characteristic that they not only rest on their supports, but try to pull these together. Such structures are called "suspension" bridges. The familiar clothesline is of this type, and a hammock is another example. We know how carefully we must guard against the tendency of these to pull their supports together. An acrobat's tight rope is likewise a suspension bridge, and it brings out the principal difficulty of this type, the tendency to change shape as the load carried changes its position. The performer walks at the lowest part of his rope, and however much interest this adds to the balancer's work, it would not do when the span became a thousand feet or more and the man a multitude. If the roadway were hung directly from cables, the bridge would be in a constant state of vibration and movement as the loads passed over the span. It must be made rigid enough so that this movement shall be small, and this is done by attaching to the cables and roadways frameworks called "stiffening trusses," which distribute any load along a considerable length of the cable and keep the lowest point of the sag always near the center of the span. The important parts of a suspension bridge, then, are the roadway, the stiffening trusses, the cables, the towers, and the anchorages.

Structures of the suspension-bridge type have been used since the earliest times. Monkeys cross the streams of the jungle by making a living suspension bridge. Savages stretch vine cables across wild rivers and thus make possible a perilous crossing. Their crude bridges have no stiffening trusses, and explorers who have tried them give vivid pictures of their difficulties. Civilized builders early adopted this type. The so-called "Chain Bridge" at Newburyport, Mass., was built in 1810, and with minor repairs did continuous service until 1909. In place of cables this bridge had long chains of huge wrought-iron links. Usually wire cables are used for the main supporting parts, on account of their great strength in small sizes and the ease with which they may be spun in place. They must be of enormous size in great bridges; for example, those of the Brooklyn Bridge have 5358 wires, making a bundle 15¾ inches in diameter, and calculated to stand safely a pull of 24,600,000 pounds. The supporting towers from which these cables hang must be high and very strong, for the weights on them are enormous. In the Brooklyn Bridge they were built of stone, but steel is more commonly used at present. The towers do not resist the pull of the cables, but the strands are carried over the tops and down on a long curve to the anchorages, where some means must be pro-

STRIKING ACHIEVEMENTS IN BRIDGE BUILDING

Left top: The Queensboro Bridge, New York. A view taken during its construction. Right top: A view looking along the suspension bridge over the Menai Strait in Wales. Left bottom: The Williamsburgh Bridge, another of New York's great suspension bridges. Note the steel towers, in contrast to the stone towers of the Brooklyn Bridge. Right bottom: Looking along the promenade of the Queensboro Bridge.

vided to hold this tremendous tension. Usually the ends are embedded in a great mass of masonry buried deep in the earth. As already mentioned, the cables are prevented from changing the form of the curve in which they hang by stiffening frameworks or trusses, which distribute heavy loads along the cables and thus keep them from changing shape like the tight rope. With great moving weights, the framework must be stout, thus increasing the dead weight to be supported by the cable. This is the chief objection to the suspension bridge for railroad traffic. When the loads are light, or where a changing sag under the load is not serious, the suspension bridge can be used to very good advantage. For very long spans it is the most economical type.

SPECIAL TYPES

Certain types of bridges which are included in our general classes of girders, arches, and suspension bridges deserve special mention. For example, where a road must cross a wide and deep valley, engineers usually adopt the trestle or viaduct form, consisting of high

Courtesy of Scientific American

A "TRANSPORTER" BRIDGE

This bridge consists of a truss span resting on high towers on the banks of tbe river. Rails and wheels are arranged on it and a long steel frame carrying a car runs on them. The trusses are above the tops of the highest masts, but the car is at the level of the river bank. By means of cables and electric motors the car may be hauled across from bank to bank at any time that a ship is not passing. Foot passengers may climb stairways in the towers and walk across the promenade on the trusses which show in our illustration, if tbey do not wish to wait for tbe car to cross. Tbe bridge spans tbe river Tees in northeastern England.

Copyright, Boston Photo News Co.

THE TOWER BRIDGE OVER THE THAMES AT LONDON

This is a "bascule" bridge, in which the roadway divides into two leaves. When the bridge is open, foot passengers cross on the upper bridge.

towers supporting short girder spans. Some of these trestles are very long and high. The passenger crossing the famous Kinzua Viaduct in Pennsylvania looks down three hundred feet to the level of the stream. Such spectacular bridges, however, offer no particular difficulties to the builder. The principal requirement is that the towers shall be strong enough to withstand the enormous pressure that comes upon them when a strong wind blows through the valley. Another interesting type includes those which carry a stream of water, either for transportation purposes, like a canal, or for water supply. Here the engineer must provide a structure that will carry an immense weight, and also be rigid and waterproof. The Erie Canal crosses the Mohawk River near Troy, N. Y., on a stone aqueduct. Again it crosses the main line of the New York Central Railroad at Syracuse by means of a steel aqueduct, consisting of an enormous trough of metal, supported on heavy steel beams.

Another special type of bridge, the usefulness of which was early recognized, is the pontoon, or bridge of boats. Pontoons are extremely valuable in military affairs because an increasing depth of water does not make them complicated or difficult. They consist simply of a series of short spans resting at each end on floats, and lashed securely to them. The width of river that can thus be bridged depends upon the amount of material and labor available and the strength of current. A pontoon bridge is really an ordinary girder

bridge, with boats in place of piers. The bridge of boats that Xerxes built across the Hellespont is probably the most famous of this type.

MOVABLE BRIDGES

The most interesting special type of bridge is that used where roads and railroads cross navigable streams at levels not much above the water. Governments as a rule take the position that the waterway existed before the crossing and therefore stream traffic has the right of way. They are usually strict in requiring that obstructing bridges shall be built in such a way that they can be removed upon very short notice. The earliest movable bridges were so built, not to permit boats to pass in the stream, but to prevent passage over the road. They were the drawbridges with which the baron of the Middle Ages spanned the moat of his castle. Wherever the wall was pierced by a doorway, a gate hinged at the bottom was provided. When one wanted to leave the castle, the gate was allowed to drop across the moat, so that its top rested on the outside bank. Then it could be drawn up, closing the doorway and leaving the canal clear. These were called "bascules," and the movable bridges of the present which lift similarly about a horizontal hinge are called "bascule" bridges. Where a wide channel is desired, they may be arranged so that a leaf comes down from each bank of the stream, meeting at the center and forming a continuous roadway. Another type, and the commonest of all, may be swung about a pier in the center of the river. These are called "swing" bridges. In one type, called the "lift" bridge, two elevator towers are built at the ends of the bridge, and its ends rest on these elevators. When a ship is to pass, the elevators are started simultaneously, and the whole span lifted vertically above the masts of the ship. To do this requires high towers, very heavy counterweights, and expensive machinery. In another type the whole bridge is pulled back across the stream; in another the girders fold up together and against the bank, something like a jackknife. A pontoon bridge, which may be untied from one shore and the loose end towed around until it lies along the other, is sometimes used as a drawbridge. Still another is called the "transporter" type, and consists of a fixed truss span, resting on a high tower at each bank, this truss being above the top of the tallest mast that is to pass. Rails and wheels are arranged on the bridge, and a long steel frame carrying a car at its bottom is hung from them. The floor of the car is level with the roadway on the bank, and when it is at one side of the stream, people may walk into it. The machinery is then started and the frame, with its hanging car, moves across the opening and stops with the floor of the car level with the road on the opposite bank.

The most difficult problem of movable bridges is to arrange machinery to handle these stupendous masses of wood and metal at an instant's notice, opening and closing the draw quickly, without serious delay to either ship or train. With most modern structures, the bridge may be moved and the channel opened in about a minute. The nicety of the workmanship may be judged from the fact that many swing bridges are so accurately built that the ends are interchangeable. Power for operating is furnished by steam or gas engines, electric motors, or man power. Both steam and gas engines are common, and, when available, electricity furnishes the best moving force. All movable bridges, however, are so arranged that in case of emergency they may be opened by man power.

To see a movable bridge opened makes one realize how well man can control the motion of great masses. For example, the New York Central Railroad crosses the Harlem River into New York over the heaviest drawbridge in the world, a four-track structure, 389 feet long and weighing 2800 tons. A tug whistles up the river. An answering whistle from the bridge tells her pilot that the draw tender has understood and will open the bridge. All track signals go to "danger" and railroad traffic stops. For a moment all is still. Suddenly the bridge moves, slowly at first, then faster and faster, until the whole enormous mass is in full rotation. Now it begins to go more slowly, and gradually comes to rest with the tracks pointing up and down stream. The tug passes, the bridge starts and closes swiftly. A moment's

hesitation, then the track signals drop to "safety" and the trains go on, delayed perhaps less than two minutes. One turns from the sight with a great respect for the minds that have planned a machine so perfect.

THE STORY OF A BRIDGE

It may be interesting to trace the history of a particular bridge, from the time that it is proposed until traffic starts over it. Suppose that two cities on opposite banks of a river wish to join their interests by means of a highway bridge. The governments of the two will agree upon a commission, consisting of men whose interests and abilities make them qualified to judge of the requirements of the problem. The commission will select a consulting engineer to advise them on the technical features of the situation, and he will study the site and prepare plans and estimates for different solutions. The commission will meet and, after considering the demands and the engineer's recommendations, will decide on a certain structure. The engineer will then prepare a final design, working out his ideas for the bridge in a complete set of plans and specifications. On a given date advertised in the newspapers, bridge contractors will be invited to estimate the cost of the bridge, and file bids with the commission before a given day, stating their prices for building it as shown. These bids are opened publicly, and the contract awarded to the lowest reliable bidder. The parties who submit figures in this way are generally large contractors who undertake work with the idea of doing parts of it themselves and of letting out the rest to other firms who are specialists in some particular line. The contract for the steel superstructure, for example, is sublet to a firm that has facilities for cutting, punching, and riveting structural steel. This bridge company, as it is called, redraws the plans completely, showing all details of the construction, with dimensions even down to the last rivet. These drawings are sent to the commission, and the engineer and the commissioners go over them, making any changes or improvements that they wish, and stamping the plans with their approval. The bridge company then orders of a steel rolling mill the steel sections of various shapes and sizes that will be riveted together to make the members of the bridge. Almost any steel bridge is made by riveting together a number of small pieces which come in standard sizes and shapes, and it is unusual to find a member which does not consist of more than one such piece. The company's shop organization then takes these pieces as they come from the mill, cuts and punches them, and rivets them together into individual members. Holes are left open that match the various pieces, so that when these arrive at the site, they may be riveted together to form a complete bridge. Before they leave the shop they are inspected for mistakes and poor workmanship, then loaded on cars and shipped to the site of the bridge. Meanwhile the contractor has been at work on the masonry of the piers and abutments, and by the time that the steelwork begins to arrive, the substructure is ready to receive it. The steel is then erected on the masonry, and when it is riveted together complete and the roadway put on, the commission, with its engineer, go over the whole bridge carefully. If all conforms to the requirements of the contract, they accept it formally from the contractor, and open it to the public.

MAKING AND SHIPMENT OF BRIDGE STEEL

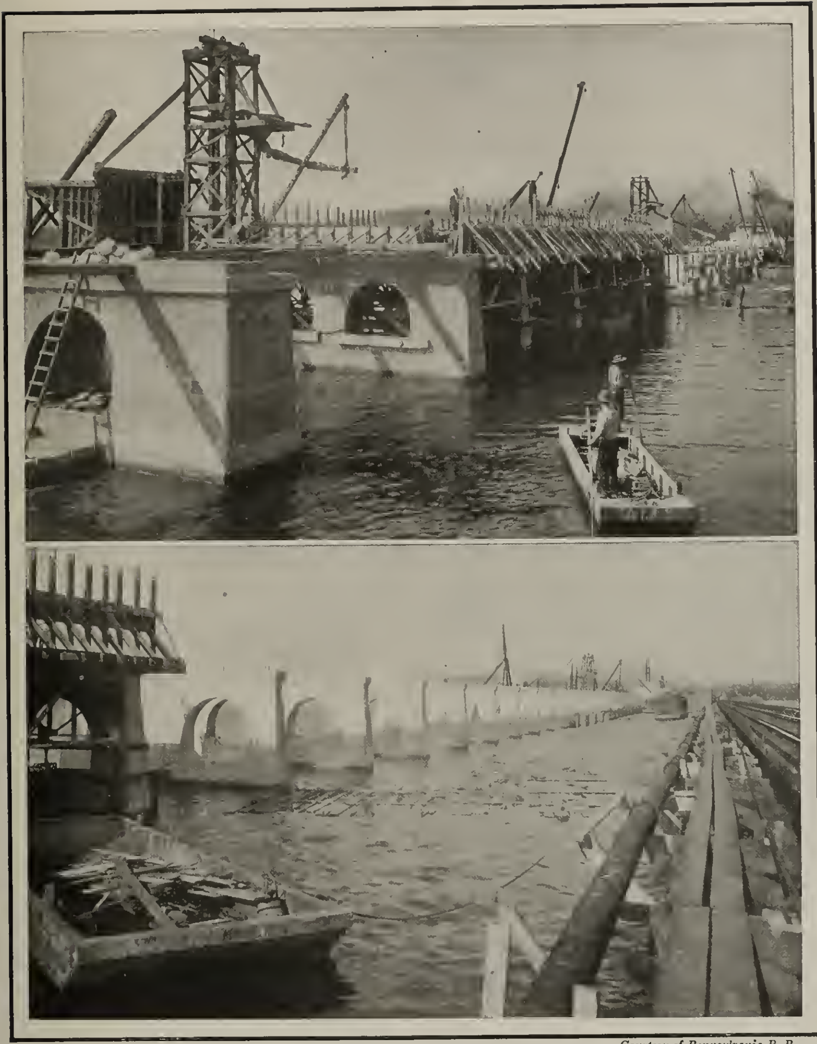
It is the policy in American bridge practice to make up or fabricate all steelwork at a main shop in some central location, and leave to the men at the site only the erection and joining of members. Some of these fabricating plants are of enormous size, notably that of the American Bridge Company at Ambridge, Pa., near Pittsburgh, which can turn out every month thousands of tons of structural steel ready to put in place.

The shipment of bridge steel from the shop to the site is at times a difficult matter. Sometimes the pieces are so heavy that special cars are required to carry the great weights. Sometimes the cars must be sent over roundabout courses to avoid bridges which might not be able to bear the heavy weights, or to avoid overhead structures, under which the loaded cars could not pass. Sometimes a piece is so long that it has to be loaded on two

Courtesy of Pennsylvania R. R.

RAILROAD BRIDGE OVER THE BUSH AND GUNPOWDER RIVERS, MARYLAND

The upper view shows the piers under construction, with the concrete reënforcing rods projecting up into the air. The picture is taken from the temporary track used by the railroad trains during construction. The lower view shows the concrete reënforcement for one of the girder spans of the bridge before the concrete is poured around it.



Courtesy of Pennsylvania R. R.

RAILROAD BRIDGE OVER THE BUSH AND GUNPOWDER RIVERS, MARYLAND

The lower view shows the piers ready to receive the girders. On the extreme right may be seen the temporary wooden trestle over which trains run during construction. The upper view shows the wooden forms ready for pouring the concrete for the reënforced concrete girders. The piers are arched to save masonry.

cars together, or perhaps on two cars separated by an "idler" car, which carries no weight. The loading of bridge material requires such skill that it is almost a trade by itself.

PROBLEMS IN ERECTION

The problems of getting steel made up and shipped to the site are often in the case of great bridges the easiest part of the job. With the erection of the metal come the real difficulties. Of course, with small bridges the erection is simple. The short-beam type of bridge, used so widely by our railroads, is shipped to the site riveted up ready to set in place. When it arrives, the piers and abutments are ready to receive it, and wrecking cranes are run up beside the car on which the bridge rests, which pick the span up, swing it over to the place where it is to be put, and set it on the masonry, ready to be bolted down. With longer spans, where the depth and current will permit, it is usual to build a timber falsework, on which the members may be assembled and riveted together, after which the trestle is removed from underneath, leaving the bridge self-supporting. Sometimes a traveling crane, built in the form of an inverted letter U, and large enough to pass completely over the bridge, is arranged to move across the river on tracks laid on the falsework. This is called a "traveler," and by means of it members may be picked up, hoisted to their proper place in the span, and held while the riveting is going on. The projecting portions of cantilever bridges may be built without falsework. This is one of the great advantages of this type of bridge. This method of erection can best be understood by referring to the plank-and-chair illustration on page 304. The two end planks are placed on the end spans so that they do not overhang, and then gradually pushed out over the center span as far as they will go. The third plank is then put on the top of one of the others and gradually pushed out over the open space until the overhanging end may be seized from the other side, pulled up, and rested on it. The shore ends of the first two planks must of course be kept down by tying or weighting them. The first Quebec Bridge was being built by this method when it collapsed. The Queensboro or Blackwell's Island Bridge at New York used this principle, for it would of course be impossible to build falsework in the East River, both because of the depth and the traffic. The method used was as follows: Falsework was built under the spans AB, DE, and GH, and the portions of the bridge in these spans were erected on it. Next the part BC was gradually built out without falsework, until a completed structure extended from A to C, in which the overhanging part BC was held by the part AB. The falsework could then be removed from span AB, leaving a structure like one of the planks supported on two chairs, and projecting into the middle space. Now the part CD was gradually built out from D to C and joined to the first arm, and similarly for the parts EF and GF. By carrying the work out in this way, no falsework was needed in the river spans BD and EG.

The Eads Bridge over the Mississippi at St. Louis was built by erecting towers at the ends of the spans and gradually building out the bridge from both ends toward the center, keeping it guyed back to the towers until the halves met. Joining the two completed halves was a difficult matter, and the structure had to be shortened by packing parts of it in ice before this could be accomplished. Sometimes a cableway is stretched over the line of the bridge and the members carried out on this and fitted into place. In some cases the bridge is built complete on shore and then pushed out across the stream, just as you would push a long plank across a brook. Where the span

THE BLACKWELL'S ISLAND OR QUEENSBORO CANTILEVER BRIDGE AT NEW YORK

is too great for this simple method, the outer end is sometimes supported on a barge and floated across. The barge is then sunk, allowing the span to come to rest on the abutment. Great bridges have been built by erecting the spans complete on barges near shore, and then floating them out to the piers, sinking the barges gradually and letting the steelwork come down upon the piers. In the case of suspension bridges, the towers are first built, then a tug drags a single cable across the river, which is pulled up and rested on top of the towers. A machine is then started across this, spinning the final supporting cable as it goes, and crossing the river once for each cable. Small suspension bridges usually have the cables made at a wire mill and shipped to the site, ready to place, but for a great bridge this would be impossible. A walk is then built on these and the workmen go out and hang from the main cables the varying short lengths that are to support the roadway. Another gang of men starts from the towers at the level of the roadway, erecting the stiffening trusses as they go. The roadway is then put on and the bridge opened for use.

REPLACING BRIDGES IN RECORD TIME

The replacing of bridges under traffic is one of the most delicate problems of the bridge engineer, for often travel over the structure must not be interrupted even for a single day. The work on the new bridge must be carried on so that eventually the load will be taken over by it. With small bridges, replacing is often done by building the new span on rollers at one side, and when there is a favorable moment between trains, the old span is wrecked quickly and the new one slid into place. With large bridges the old structure must often be used to support the weight of the new structure during erection, as well as the ordinary loads, and at the same time the old steel must be gradually removed as the new progresses, to keep them from interfering. The replacing of the old suspension bridge at Suspension Bridge, Niagara Falls, by the steel arch bridge which is there at the present time, was one of the very difficult problems of bridge replacing, but the whole work was carried through without the interruption of train service, or serious accident.

THE PROBLEM OF THE ENGINEER

Although the engineer's knowledge of the laws of mathematics and materials has made possible the great bridges of the present, yet in engineering, as in everything, the experience and judgment of the individual are great factors. In some cases these have not been adequate for the task. In 1878 a great bridge, over two miles long, was built over the Firth of Tay in Scotland, and for a time it was considered a marvel of bridge engineering. One winter night in December, 1879, a train left the station on one shore during a heavy gale, disappeared in the darkness, and never reached the other side. In the morning several spans of the bridge were seen to be gone, and divers found the tangled mass of steelwork and train at the bottom of the bay. Eighty people lost their lives in this accident. The commission which reported on it laid the blame for the disaster to the faulty judgment of the engineer in not designing the bridge strong enough to withstand the pressure of the wind. Another terrible accident was the failure of the cantilever bridge over the St. Lawrence River at Quebec in August, 1907, when seventy-five out of the eighty-six workmen on the bridge met death in its fall. The structure was but half done at the time.

Notwithstanding these frightful accidents, no one needs to worry about the safety of our modern bridges. At the time of the Tay accident modern bridge building was merely in its infancy. Few experiments had been made on wind pressure, and there was little precedent for a structure of such magnitude. In the case of the Quebec Bridge, too much reliance was placed on the knowledge and judgment of one man.

FUTURE DEVELOPMENTS

Future developments in bridge engineering will tend gradually to lessen the use of wood and probably of steel, and increase the number of bridges built of concrete. The end of the available supplies of timber and iron at the present rate of consumption may be predicted, but

the materials from which concrete is made may be had in any quantity. When it is reënforced with steel bars embedded in it, it has great advantages of strength, firmness, and cheapness, and its fireproof qualities make it invaluable. The principal use of concrete will be for spans of small and moderate length. Great spaces will probably continue to be bridged with steel.

Future developments in bridge building will be greatly influenced by the type of our railroad rolling stock. If locomotives and cars of the present variety continue to be used, the change in bridges will be principally in the direction of increasing weight, with the present form but slightly modified. If, however, the gyroscope monorail car comes into general use, the inventor claims that a single cable stretched across a gorge will replace the complicated frameworks which must now be used to carry our trains. The general adoption of such cars would revolutionize the art of bridge building.

Where transportation must be arranged across a great river, three methods suggest themselves. A bridge may be built to carry you over it, a ferry arranged to carry you across it, or a tunnel constructed to carry you under it. The disadvantages of the ferry are obvious. The choice usually will lie between the other two. In the past the bridge has usually been chosen, but the increasing ease with which difficult underground work may be done, and its permanence when once completed, make engineers look with great favor upon it. Bridges will always be built, however. Even the universal use of flying machines cannot entirely do away with them, and they will continue to be one of the great factors in our transportation system.

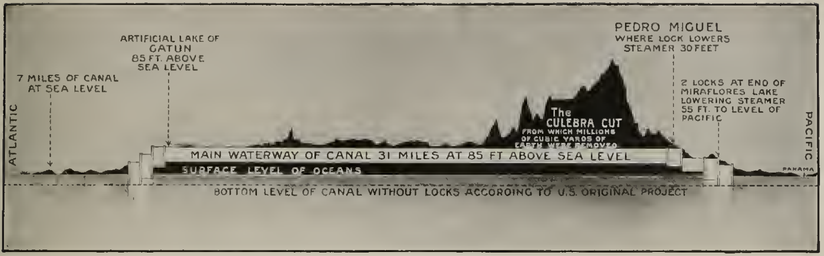
THE MONROE STREET BRIDGE AT SPOKANE, WASHINGTON

This is a fine example of a modern reënforced concrete, arch bridge. The span of the largest arch is 281 feet.

Copyright, Underwood & Underwood.

THE COMPLETED CANAL

At the top is shown the east wing wall and the south approach wall of the Gatun Locks, in the center the completed canal at a point opposite Corozal looking north, and below, the south approach wall and the waters of Gatun Lake.



PROFILE OF PANAMA CANAL

THE PANAMA CANAL

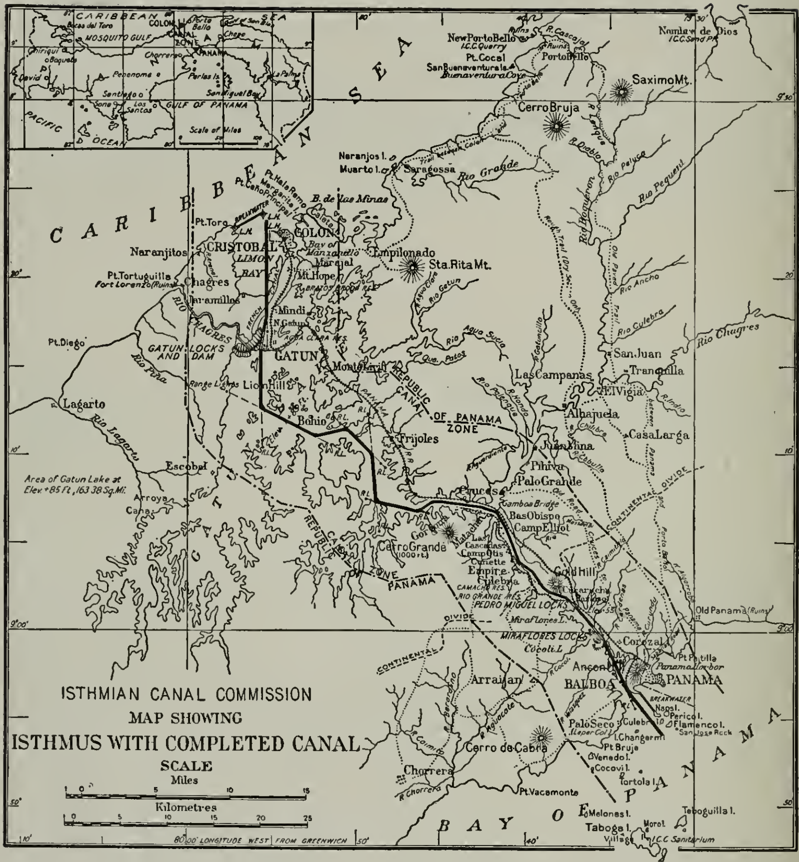
CUTTING A CONTINENT IN TWO

GEOMETRY teaches that a straight line is the shortest distance between two points, a lesson that Nature herself has learned and that she has taught her forces well. We know how light streams out in straight rays, and how the path of a falling body is drawn more and more to a straight line. In accordance with the same law, man, as he travels from place to place on the globe, tries to go quickly and is not content unless he is moving over a course that is reasonably direct. If on land, a mountain range or a river may be interposed, but he bores a tunnel or builds a bridge; if on sea, he may find a continent in his path, and then he digs a canal: all these in order that he may travel more nearly in a straight line, the line of shortest distance.

EARLY ATTEMPTS AT CANAL BUILDING

For centuries two places on our earth baffled man in his wish to sail the shortest distance. The continents are so joined that the Atlantic and the Pacific oceans meet only at the far south and in the frozen north. In almost prehistoric times the people of the Eastern continents tackled their problem at Suez and endeavored to join the waters of the Mediterranean with the Red Sea. Their success was doubtful. Whatever small trench they may have dug was soon filled by the drifting sand, and again the desert waste remained unbroken for ages, until the middle of the nineteenth century, when, under the leadership of Count de Lesseps, a small ship canal was slowly excavated across the isthmus and opened in 1869 with great triumph. The story of the Suez Canal is told on page 380.

The sister enterprise at Panama had long been a dream of imaginative men. Almost with the discovery of the Pacific from a peak near Panama, the possibilities of a waterway between the oceans had made its appeal. Many schemes were brought forward, but the difficulties were stupendous. The moist, unhealthful climate, the tropical jungle, the swamps, the backbone of a continent to be surmounted, all these discouraged and disheartened, but the idea still remained alive. The king of Spain did not want the canal dug because he thought it would give his enemies access to Spain's unprotected dominion on the Pacific. To support his contention he quoted from the Bible, "What God hath joined together, let not man put asunder." But the project was too great for any but modern times to grapple with successfully. It slept fitfully until the French, flushed with their success at Suez, had surveys made, obtained grants from Colombia, organized a company, and under the leadership of Count de Lesseps began the construction of a sea-level canal at Panama in 1879 — the first scratch of the gash which under other hands, directed by superior minds, was to become the greatest engineering wonder of the world.



ISTHMIAN CANAL COMMISSION
MAP SHOWING
ISTHMUS WITH COMPLETED CANAL

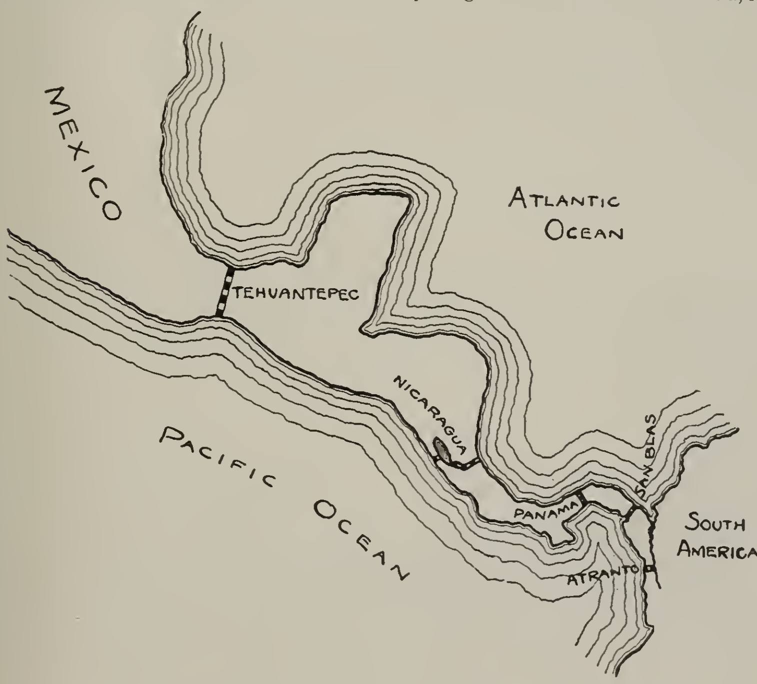
PANAMA, THE SPANISH CITY

The Atlantic Ocean, up to the sixteenth century, was the sea of exploration, conquest, and colonization. The Pacific was unknown. In fact it was supposed that the Atlantic extended all the way to the Indies. When the great new ocean was discovered, the wealth gathered there through trade and torture must be poured back over the Atlantic to kings and capitals. Either the Isthmus must be crossed, with its perils of disease and robbery and murder, or a ship must brave the dangers and terrors of a long voyage around the continent. Usually the first was considered the lesser evil and the trail across the narrow strip of land was much traveled. The cruel soldiers, who so early made the name of Spain infamous in the New World, would collect their booty along the coast of the Pacific, sail with it to Panama, carry it across the Isthmus, and reëmbark with it for Spain. The importance of this neck of land

was early realized and nations struggled for its control. Spain held it successfully, though at intervals its cities were robbed and pillaged by buccaneers. A city grew up on the Pacific side, whose wealth, fame, and immorality were hardly surpassed by Babylon. But it caught the attention of an English pirate named Morgan, and after a hard campaign across the Isthmus he conquered, pillaged, and burned it. A new town was founded on the Pacific, the present city of Panama, and settlement began on the Atlantic side, where Colón now stands. Still the tide of men flowed over the road between the oceans, always greater and greater and greater.

VARIOUS CANAL ROUTES

As knowledge of geography increased, other routes began to compete with Panama for travel between the seas. There are several places where the continent is narrow, and when isthmian canals became more talked of, these locations were seriously considered as possibilities. Tehuantepec, Nicaragua, Darien, each had its advocates. Not only canals but other schemes were proposed to take ships across the continent. Captain Eads, who built the deepest foundations in the world for his bridge across the Mississippi at St. Louis, and made navigation possible for great ships at the mouth of the same river, proposed to build a ship railway across the Isthmus of Tehuantepec, by means of which a ship could sail into a submerged rack, which could then be dragged by locomotives up out of water and overland to the ocean on the other side. So daring a scheme found but little support, and it died with its originator. By using the river Atranto in Colombia, it was



MAP SHOWING THE VARIOUS ISTHMIAN ROUTES

proposed to build a canal at sea level, but instead of making the necessarily enormous excavation, the scheme was to tunnel the mountain with an opening large enough for ships to pass. This was never carried forward, for the increasing size of vessels soon ended its possibility. At about the same time, a ship canal and tunnel were also proposed across the Isthmus a hundred miles or so down from Panama. This San Blas route, as it is called, gave a total length of about thirty miles, the shortest of them all. But the most active competitor of the Panama plan was the Nicaragua route, somewhat longer, it is true, but supposedly easier to construct. It crossed active earthquake country. Indeed, the greatest works on the line would have had to be within a few miles of an active volcano. This scheme, however, served the United States well, for it showed that in canals, as in business, competition is a good thing. When the owners of the old Panama enterprise and the little South American republic tried to hold up the United States for more favorable terms, the threat to adopt the Nicaragua location helped to bring about a satisfactory agreement.

THE PANAMA RAILROAD

Long before the time was ripe for a canal, far-seeing men recognized the possibilities of improved transportation facilities across the Isthmus. The rush to California for gold had begun, and in 1849 American capitalists had surveys and estimates made, and began the construction of the Panama Railroad. No one who has not endured the tortures of the tropics can imagine the suffering of the men who carried this enterprise to a successful finish. Working in swamps, harassed by insects day and night, with disgusting food, loathsome sleeping quarters, the perils of yellow fever and malaria hanging over them like the sword of Damocles, they persevered and won. The price in human life paid for the building of this railroad was enormous. Financial support for the enterprise was hard to gain, and for a time things looked very badly. Construction had progressed but a little way from Colón, when the gold seekers began to catch rides on the railroad, glad to have the terrible journey made easier by even a few miles. The superintendent tried to stop this practice by charging the supposedly prohibitive rate of fifty cents a mile, but to his surprise the men paid it willingly. This new income demonstrated the earning possibilities of the road, and enabled its promoters to continue with its construction. New capital in the United States was interested and building was pushed forward to completion. For years, however, the charge was fifty cents per mile or twenty-five dollars for the transcontinental trip, just because the traffic would bear it. The railroad not only earned enormous dividends for its stockholders for many years, but when the French canal company began work, they found that they must have the road to transport supplies. So they paid the owners the enormous price of eighteen million dollars for it.

THE FRENCH ATTEMPT

French thrift and shrewdness, led on by the success of the Suez Canal and the Panama Railroad, saw in the Panama Canal a great money-making opportunity. Accordingly it was a simple matter for De Lesseps to win confidence in his plans and get, it seemed, almost unlimited support for his canal venture. The surveys under which his company started work were undertaken under the direction of Lieutenant Wyse of the French army, who carried back to France complete plans and detailed estimates for a sea-level canal, but who, as it afterward turned out, had never been the whole distance across the Isthmus. The opinions of prominent engineers who foresaw some of the coming difficulties were completely disregarded, and, with boundless enthusiasm, the work started. The stupendous difficulties of the task became apparent from the beginning. No attempt was made to improve the sanitary conditions of the country or to provide even the simplest and most necessary comforts for the laborers. The death rate was enormous, appalling. Human life seemed worth nothing. In constant expectation of disease or death, men kept up their courage by the most riotous dissipation. Because the water supply was so poor, wine had been imported in enormous quantities from France, and this was sold everywhere at the lowest prices, with disastrous results. The

Copyright, Underwood & Underwood

THIRTY YEARS AT PANAMA

The top view shows how the French left Culebra Cut. The picture was taken about 1885. The other view shows our completed canal, looking toward the lower Miraflores lock.

nights were orgies. Not only was there immorality in matters of living, but the opportunity offered by the loosened purse strings of the French people was too good to be neglected, and the result was graft and extravagance on the most surprising scale. Men in charge built enormously expensive houses, gave themselves large salaries, and allowed themselves princely traveling expenses. There were dummies on the payrolls, dishonest commissions, unnecessary expenditures, everywhere disregard of all that was right. It is said that among the machinery discovered in a warehouse when the United States took possession was a large number of snowplows.

The drain was too great, and the seemingly inexhaustible source of wealth eventually ran low. Then came difficulties. More capital must be supplied, and again the French people were called upon. After great discussion and disagreement, the scheme was changed from a sea-level canal to a lock canal, the dimensions of which were such that even had it been completed, it would have been too small for the demands of this century. Again the work proceeded, but the outcome was a foregone conclusion. In 1889 the company collapsed and work on the project stopped. It is interesting to note that during all the years from that time until the United States took over the canal, the receivers of the French company kept a few men at work constantly, in order that their rights in the enterprise of constructing the canal might not be taken away from them. The spectacle of a handful of men with carts, digging away at Culebra Cut, must have reminded one of that faith which moves mountains. It was faith justified, too, for now it was but a question of decades when Culebra should be conquered.

ENTER THE UNITED STATES

The matter of an interoceanic canal had always been an important one in the United States, and this was especially true after the entrance of the United States into Latin-American affairs with President Monroe's enunciation of the so-called Monroe Doctrine, which recommended a very fatherly interest in the workings of the nations to the south of us. It had always been felt that such a canal ought to be the enterprise of the United States, but the stress of working out our own problems had left us little opportunity to consider the canal situation. During Grant's administration, after we had had a breathing spell from the Civil War, the question came up definitely and a commission was appointed to look into the matter. In 1876 it reported in favor of the Nicaragua route, and after further investigation a company was organized and some excavation made on the line of this canal, but it lacked the support of the government, and soon failed. Panama and Nicaragua still divided the interest of this country. The French company reorganized in 1894 and, under new management, gathered much useful information and made careful plans and estimates for a lock canal. It is very likely that they might have put it through, if the United States had not entered the field as a possible competitor at Nicaragua, but by that time our interest and enthusiasm were aroused. With the possibility of bargaining between two routes, we were able in 1899 to come to favorable terms with the French Panama company, taking over their rights in both canal and railroad for the reasonable sum of forty million dollars.

The situation was complicated, for the government of the United States of Colombia, with which Panama was federated, withheld its consent to the transaction and refused to sign the necessary treaties, holding out for greater concessions and more favorable terms. The whole enterprise seemed likely to go by the board in favor of the Nicaragua route, when certain prominent men in Panama, fearful that their country would lose its only opportunity to become of real commercial importance in the world, instigated a revolution, in consequence of which Panama seceded and became an independent state, the Republic of Panama. The administration of the new nation was thoroughly in sympathy with the United States and no difficulty was experienced in coming to an agreement regarding the relations of the two countries. Colombia claimed injustice, and later presented her case. She had a valuable privilege to bestow, and no doubt she had the right to hold out for the best possible terms, but the building of the canal was demanded by the economic progress of the world, and Colombia was holding off simply to squeeze more money out of the

VIEWS ALONG THE CANAL

The upper picture shows the method of excavating by washing down a bank with a stream of water from a high-pressure hose. The lower view shows the great American waterway (on the left) at the point where it crosses the old French canal.

United States. Our experience in dealings with her had not been such as to inspire confidence, and we realized, too, that money paid for concessions would very likely stick to someone's fingers before it reached the national treasury. The United States did not officially abet the revolutionists, but whatever moral support it may have given them seems amply justified by the magnitude of the good accomplished.

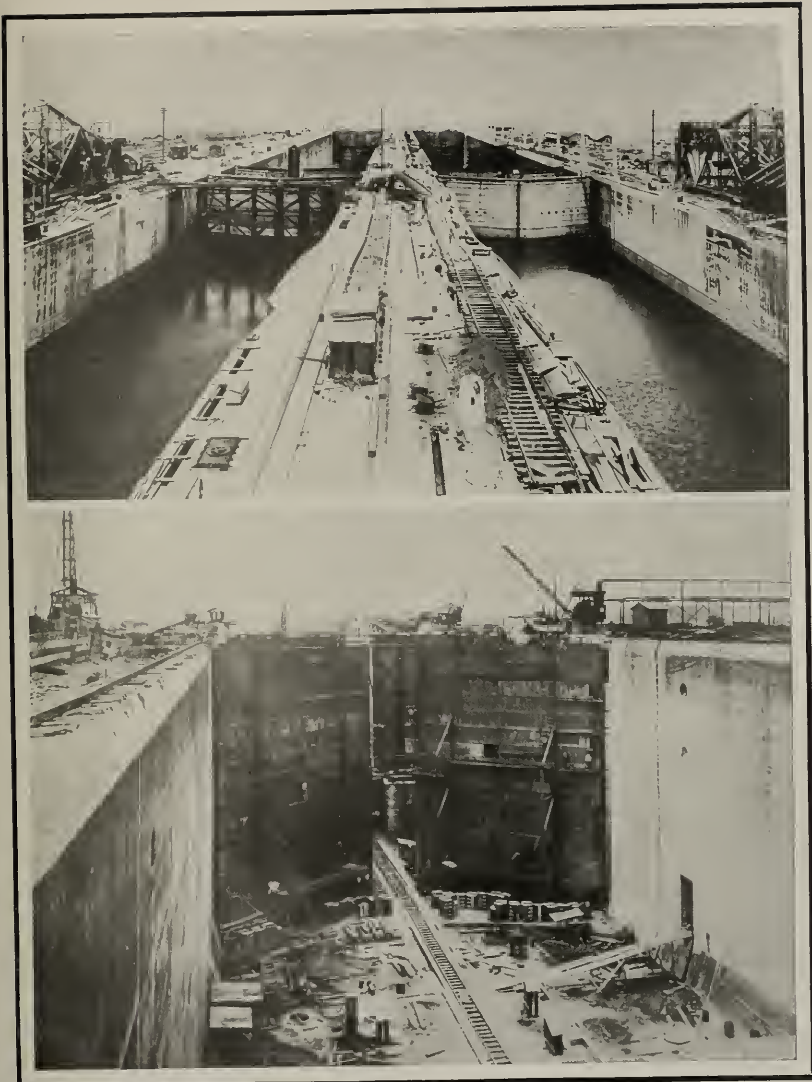
THE AMERICANS AT PANAMA

When we became possessed of the canal rights across the Isthmus of Panama, we found ourselves face to face with great problems: the sanitation of the country, the choice of a type of canal, and the organization of the undertaking. Probably, of these, sanitation was most important, for without that it is doubtful if the work could have been carried to completion. The complete organization of the whole job had to be developed. These were immediate problems, while the decision as to the type of canal might be delayed. It offered food for the most bitter controversy. Supporters of the sea-level type, or "The Straits of Panama," as it has been called, wrote impassioned arguments against the lock canal, and their opponents were just as caustic.

The first thing done was the appointment of an Isthmian Canal Commission, and this was done by President Roosevelt in 1904. Appropriations were made by Congress, the property of the French company, including the Panama Railroad, formally taken over by the United States of America, plans for the organization worked out and approved, and the sanitation of the Canal Zone started under the direction of Colonel Gorgas. The latter's experience in Cuba after the Spanish War enabled him to understand the needs of the case, and in a short time the cities of Colón and Panama, which were the worst pestholes, had been thoroughly gone over and cleaned up, houses fumigated, sewer and water pipes laid, and streets paved. The key to the whole problem of making the tropics habitable to white men from temperate climates was the important discovery that the only possible way of taking yellow fever or malaria was through the bite of a mosquito which had already feasted on a person suffering from one of these diseases. The fact had been proved beyond all doubt by the careful tests in which Dr. Lazear, allowing himself to be bitten by infected mosquitoes and contracting yellow fever, died a willing martyr in the cause of science. Knowing the secret of these dreaded diseases, it was dealing with an open foe to fight them, and, under Colonel Gorgas, the work has been so well done that at the present time a mosquito in the Canal Zone is the exception rather than the rule. The health department's most effective weapon against these insects is a simple oil can. These are placed at the sources of streamlets and arranged so that the oil drips gradually into the water and is carried down the brook into the pools and swamps, spreading over the water everywhere and forming a thin film. When the "wigglers," or young of the mosquito, rise to the surface of their native pool to breathe, they are unable to pierce this thin film of oil and they suffocate.

The organization of the canal force as originally planned did not work smoothly. After trying two chief engineers from civil life, John F. Wallace and John F. Stevens, each of whom resigned after a short term of office, President Roosevelt reorganized the commission, and appointed Col. George W. Goethals chief engineer and chairman of the commission, with almost despotic power over the Canal Zone. The arrangement has worked wonderfully well. Mr. Wallace and Mr. Stevens, both great engineers, gave the enterprise their best efforts and helped it to success. Mr. Stevens is a railroad man of wide experience, and the plan of track arrangement that he laid out for handling the material excavated from Culebra Cut has been one of the great aids in the solution of a hard problem.

A sea-level canal or a lock canal — upon that point it seemed as if no agreement could be reached. The work of excavation was carried forward pending a decision, until decision was imperative. A board of consulting engineers, chosen from the most eminent men of that profession in the world, was called by President Roosevelt in 1905. This consisted of eight Americans and five Europeans. After much deliberation, eight of the members voted in favor of the sea-level canal, and five, all of whom were Americans, voted against it, each



PANAMA CANAL LOCKS

These pictures show the locks and gates at Gatun, both during construction and after the water was let in. At the sides of the upper view may be seen the emergency dams, which are arranged so that in case of accident to the lock gates, these structures may be swung across the locks and let down into them to keep the water from running out.

side presenting its arguments in a report. The Commission, the Secretary of War, and the President were all in favor of the lock canal, and after long debates in Congress, this type was adopted.

HOW A LOCK WORKS

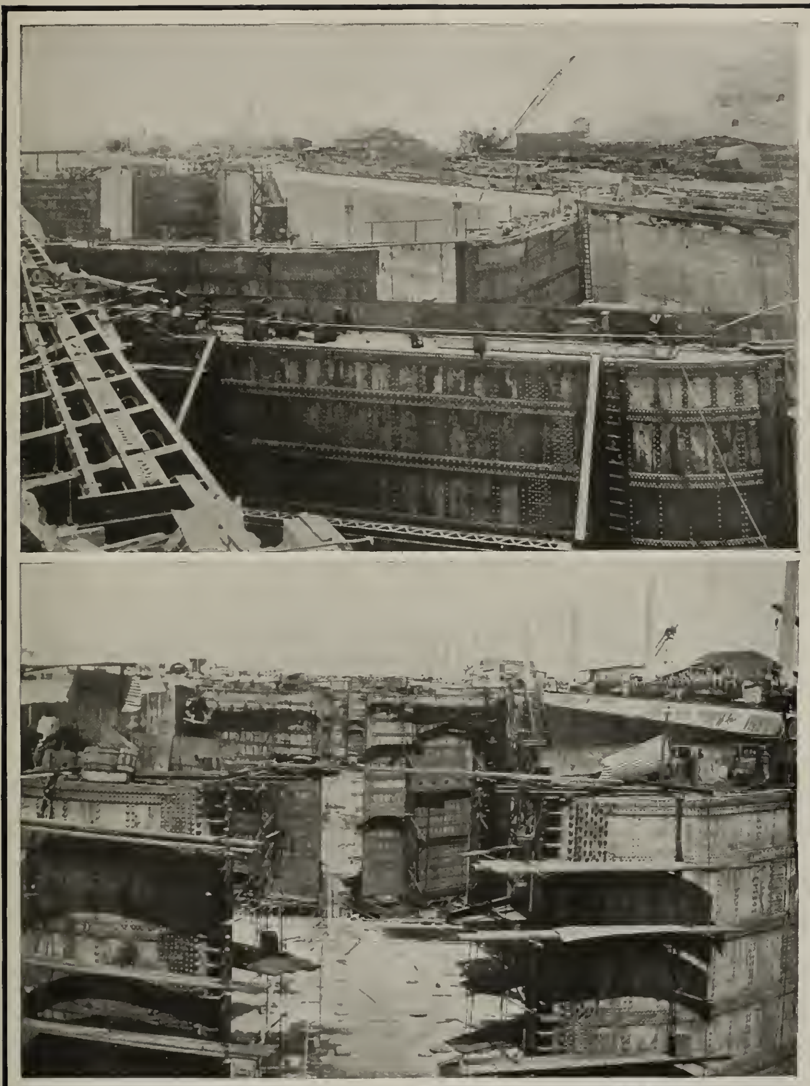
Before we can understand the problem thus decided, we must first understand what a lock is and how it works. Suppose that a small boy is sailing his toy boat in the bathtub, and that the water is just deep enough to float the ship. If he turns on the faucet and lets the tub fill up, the water rises and lifts the boat with it. Suppose the overflow from this tub runs out into the bottom of another tub somewhat higher than the first, and he sails the boat out of the first into the second, turns off the water in the first, and shuts up the opening into the second. The boat is now sailing in a few inches of water in the bottom of the second tub at a level higher than at the start by about the depth of a tub. Now if he turns on the faucet in this tub he can lift the boat still more in the same way. This, then, is the lock principle, to pour water into a tank in which the ship to be raised is floating, and, by raising the water level, raise the ship. When it has been raised as far as is practical or desired, the side of the tank is opened, it is floated out into the bottom of a tank at a higher level, the side of this closed, the water let in, the ship raised, and the process continued as much as it is desired to raise the boat. The arrangement works the other way just as well, for the boy can lower his boat through the system of tubs by pulling out the plugs and letting the boat sink with the falling water levels. Sometimes there are many of these locks end to end, and by means of such a "flight," as it is called, the boat may be raised many feet. In all cases the principles are the same and the arrangements similar: a channel through which a ship may enter the chamber, gates which may be closed, making the chamber tight, passages through which water may be poured in, raising the water level in the lock chamber, and incidentally the ship which is floating in it, and gates which may be opened at the other end of the chamber, allowing the craft to sail out at a higher level.

A SEA-LEVEL CANAL OR A LOCK CANAL?

In some ways it would be an advantage to have a sea-level canal at Panama, but the gain does not begin to balance the disadvantages. In the first place, advocates of the sea-level canal are careful not to call it a lockless canal, for one lock at least, and probably two, would have been necessary, since there is practically no tide on the Atlantic side and twenty feet on the Pacific. If there were no gates to stop it in a sea-level canal, the Pacific would try for twelve hours of each day to raise the level of the Atlantic by pouring a raging torrent through the canal, and, for the other twelve hours, the Atlantic would be trying to raise the Pacific by a flood pouring through in the opposite direction. This state of affairs would of course make navigation impossible, and therefore any sea-level canal must have locks and gates, if built at this location. The cost of building a sea-level canal would be immensely more than for the lock canal; the channel would have to be narrower; it would be years before it would be complete; the slides at Culebra would be a much more serious menace to its safety than they are to the present canal; and, what is probably the most important of all, the satisfactory control of the Chagres River during freshets, when it would try to pour its enormous flow into the sea-level canal, would be almost impossible without stupendous cost. Arguments against the lock canal seem to be, that the safety of the Gatun Dam is doubtful, or that locks in general are not safe. The safety of the Gatun Dam is beyond question. It is a hill of earth, a mile and a half long, a half mile thick at its base, and 105 feet high, laid down in a manner that makes it simply impregnable. The experience of the canals of the world has been that properly managed locks are perfectly safe and, what is more, the Panama locks have about all the safety devices ever proposed for other canals, with many additional original ones. It seems now to be almost universally felt that no mistake was made in choosing a lock type of canal.

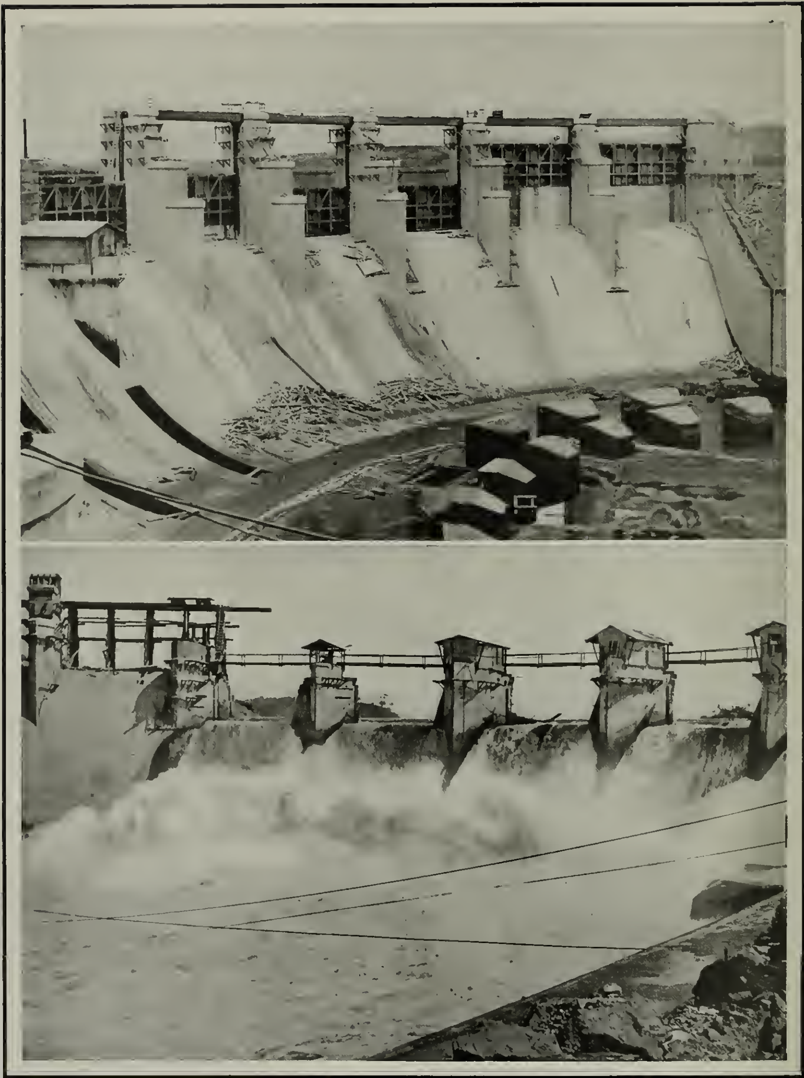
GENERAL FEATURES OF THE CANAL

Let us turn to our map of the Isthmus showing the Canal Zone. One notices first that the



LOCK GATES OF PANAMA CANAL

These views show some of the lock gates at Gatun while under construction. Note the middle pair in the upper view, which are the ones used to make a short lock when passing a small boat.



Copyright, Underwood & Underwood

GATUN SPILLWAY

In the upper picture may be seen the movable steel gates on top of the concrete. These may be raised or lowered to regulate the level of Gatun Lake. The lower picture shows the spillway discharging a freshet flood of the Chagres River at the rate of about fifteen thousand cubic feet per second.

canal runs from the Atlantic southeast to the Pacific, so that the Pacific end is actually to the east of the Atlantic end. This is of course due to the shape of the Isthmus, which also gives rise to that remarkable phenomenon of the sun's rising from the Pacific or Western Ocean, which may be seen at Panama. Let us look at the country between the cities of Colón on the Atlantic and Panama on the Pacific. The Isthmus at this point is about forty-five miles wide, low and swampy near the Atlantic, growing gradually higher inland until the summit or continental divide is reached, about thirty-five miles from the Atlantic. From that point the slope is quite sharp to the Pacific. The top of the divide at the canal location is about 312 feet above the oceans. About halfway across, one notices the Chagres River flowing along the Isthmus until it runs into the great Gatun Lake, which extends from that point almost to the Atlantic. This lake occupies what was originally the lower basin of the Chagres River valley. Looking more closely at the map, we see the line of the canal shown, starting near Colón, running inland about seven miles to Gatun Lake, passing through this for twenty-three miles, entering the narrow channel through the divide, and passing through Culebra Cut for eight miles, then for five miles through a small lake and a short channel to the Pacific near Panama. The canal is about in the center of a strip of land ten miles wide, the Canal Zone, which we do not own but over which our control is perpetual. If we were to slice the Isthmus apart at the canal and removing one side hold the other up to the level of our eyes, we should see the profile, as it is called, of the canal. This shows us distances along the channel and also the depths and heights of land and water at all points in our slice. Engineers have prepared such a profile by means of accurate measurements, and we have reproduced one in our illustration on page 319. Let us go over the line of the canal on this profile or slice view and notice its peculiarities.

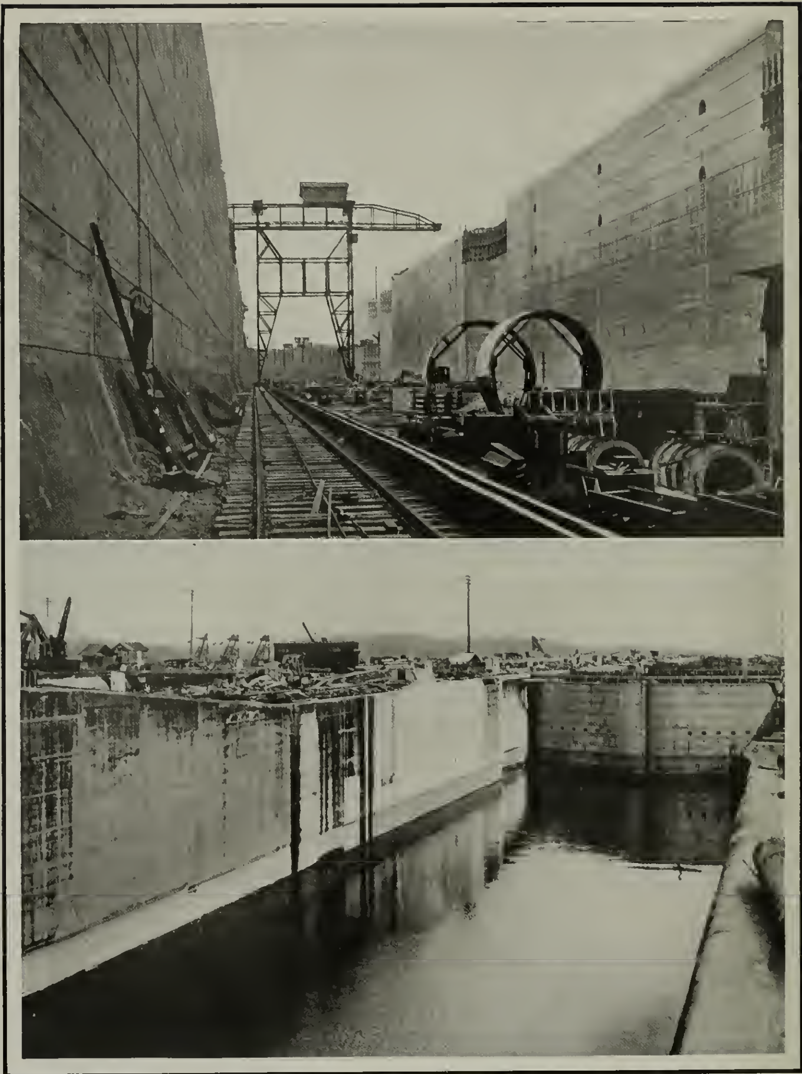
In order that ships approaching the canal from the Atlantic should have deep enough water, it was necessary to begin a dredged channel about five miles off shore and carry it in to the beginning of the canal proper. The canal, with level bottom, runs in to Gatun, rising there a total of eighty-five feet in three steps or locks, and reaching the level of Gatun Lake. From this point it runs through the lake and through Culebra Cut to a point known as Pedro Miguel, where there is a lock with a thirty-foot step down, then the small Miraflores Lake, then two more steps down, dropping it fifty-five feet to the level of the Pacific. From this point it runs out to the shore and then off into the Pacific in a dredged channel, making a total length of about fifty miles from deep water to deep water. The Pacific end had to be deeper than the Atlantic, due to the greater rise and fall of the tides on that side. Let us imagine that we are to pass through the canal from the Atlantic to the Pacific, and examine in detail the things that we shall see.

A TRIP THROUGH THE CANAL

We sail in from the Atlantic past the great Toro Point breakwater which protects the end of the canal from the severe tropical northerly storms, into the dredged channel which is really the canal under water. Entering the canal proper, we steam for a few miles through a broad waterway between low, marshy shores, at one point crossing the narrow ditch of the old French canal. Finally our way is barred by a long, low hill, at one end of which we see an enormous mass of concrete masonry rising in gradual steps. We have reached Gatun with its famous dam and locks. Let us leave the ship for a time and go over the works.

At this point the Chagres River valley is only a mile and a half wide, and the low hill that we noticed is an artificial mountain of earth, consisting principally of material brought down from Culebra Cut and dumped here across the valley to hold back the waters of the river and form an immense artificial lake. Ships are raised into this lake, whose level is eighty-five feet above the Atlantic, by the flight of three locks, whose total length with approaches is about one mile. The locks are arranged in pairs, so that one ship may be ascending and another descending at the same time.

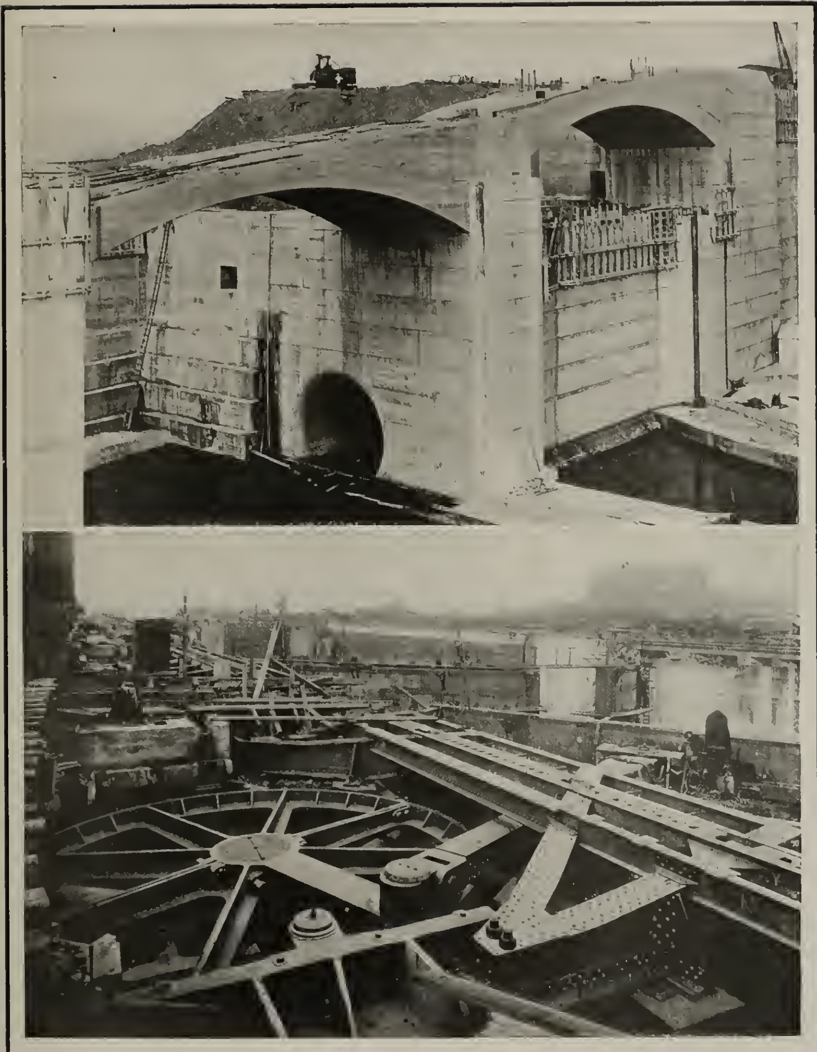
We watch our ship led through the open gates of the lowest lock by several powerful electric towing locomotives, which run on tracks laid on the lock walls. The gates through which she



Copyright, Underwood & Underwood

PANAMA CANAL LOCKS

The upper picture is taken at the bottom of one of the Miraflores locks. Note the circular steel forms for the great water passages in the walls, the traveling crane used in the construction of the lock which runs along the track where we are standing, and the bulkhead at the farther end, which keeps back the Pacific Ocean, forty feet above our heads. The bottom view shows us one of the Gatun locks.



Copyright, Underwood & Underwood

PANAMA CANAL LOCKS

The upper view shows the reënforced concrete arches in the approach to the Pedro Miguel lock. The towing locomotives run on tracks over these. Note the great opening under the lower arch, through which the water is let out of the lock to lower a ship. The bottom view shows the machinery for operating a lock gate.

entered are closed upon her, and through passages larger than a railroad tunnel water rushes in, raising the level of the water in the lock and lifting the ship with it. When she has been raised so that the water level is even with that of the second lock, the gates between these two are opened and the ship sails into the second lock. These gates are then closed and water let into this lock, raising her to the level of water in the third lock, into which she is then passed. The lower gates are closed and the rising water lifts her to the level of the water in Gatun Lake, the gates are opened and she is towed out into the lake, still under the care of the towing locomotives, but now ready to continue her voyage under her own power at a level of eighty-five feet above the ocean. The whole passage of the locks may have taken perhaps an hour and a half.

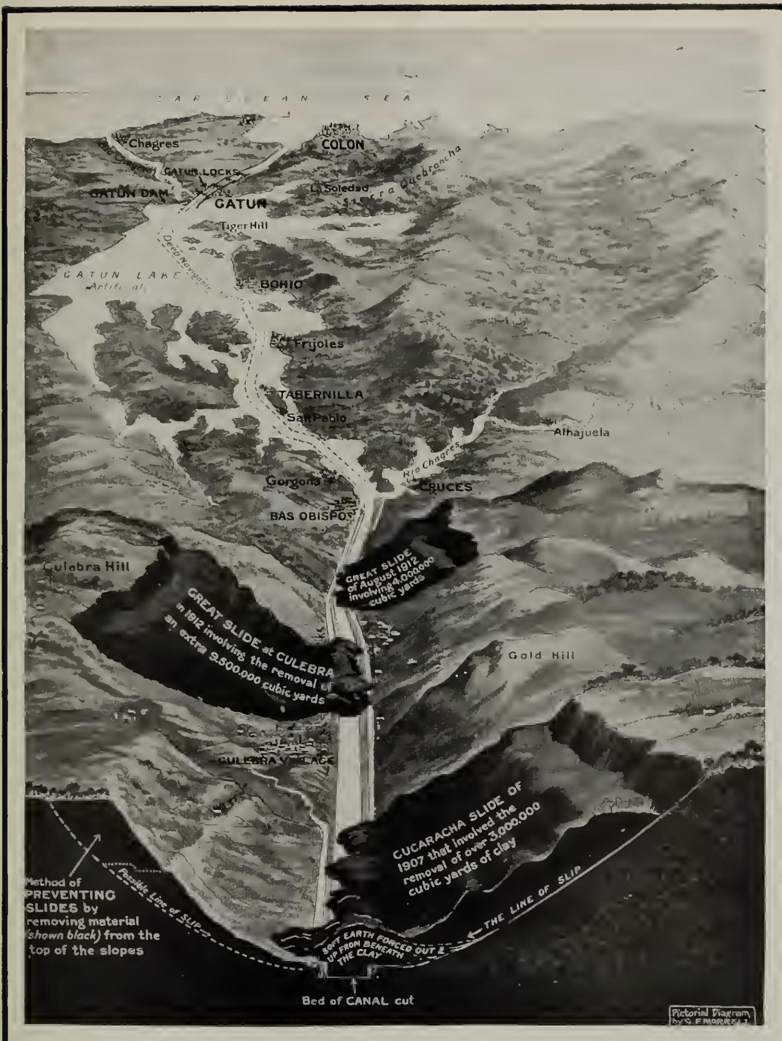
The size of these locks is stupendous. They are 1000 feet long and 110 feet broad, large enough to take a greater ship than any now afloat. In order not to waste water in passing a small ship, they are arranged with intermediate gates which make what amounts to smaller locks. The lock structure is so deep that if an ordinary six-story office building were set in the bottom of one of them, a man on the roof could step off on the top of the lock wall.

The Gatun Dam, by holding back the flow of the Chagres River, makes Gatun Lake, the great advantage of which is that it furnishes a reservoir in which the freshets of the river can spend their force without damage to the canal. Sending boats through the locks uses water from the lake, but in rainy seasons the flow of the river is more than sufficient for this and the surplus must be allowed to run to waste. To take care of this flood water, which at times pours down these tropical streams in enormous volumes, a great concrete spillway was placed in the dam. Its enormous size may be judged from the fact that it is 285 feet long, allowing any possible flood to dash over it without harm. The spillway and the lock structures are of massive concrete, but the dam itself is of earth and rocks.

Extending into the lake from the lock structure is a long wall to which ships can tie. Here we find our vessel and we go aboard for the rest of the journey. Leaving Gatun, we steam at full speed for miles through the inland sea that but a few years ago was a tropical jungle. Finally the lake grows narrower and narrower, until we realize that we are in the canal again. The sides grow gradually steeper and higher, until we see before us the great Culebra Cut, where we are to pass across the backbone of a continent. Even in this narrowest part the waterway is wide enough for ships to pass easily and safely. We have now reached the deepest part of the cut, and on the slope of Gold Hill at our left we can see the highest point of the excavation, over four hundred feet above us. We see the marks of the great slides, which have so often threatened to overwhelm the canal, but which have been conquered by the perseverance of the workers. Soon the banks grow lower and the slopes more gradual, and we have arrived at Pedro Miguel, where we make our first step down to the Pacific from the level of Gatun Lake on which we have been sailing. The ship enters one of the twin locks and is gently lowered thirty feet to the level of Miraflores Lake, which is a small edition of Gatun Lake. We sail quickly through this to the Miraflores locks, which lower us easily in two steps to the level of the Pacific. A few miles of channel and we are at Balboa, the new town at the Pacific end of the canal, which, as the administrative headquarters, is to be the heart and brain of the working canal. We bid farewell to our ship here, for there is much still for us to see on the Zone.

Balboa is partly built on a plain, made, like the Gatun Dam, of material excavated from Culebra Cut. Near by starts the long breakwater which runs out to an island in the Bay of Panama and protects this end of the canal from the great waves of the Pacific. Beyond may be seen the little islands where rise the fortifications for the protection of the canal, which caused so much distress to the lovers of universal peace.

We can take a carriage from Balboa to Panama and spend days in that interesting city. In the American suburb, Ancon, the United States operates a magnificent hotel, which most Americans visiting the Zone make their headquarters. We will return to the Atlantic side by the Panama Railroad, which within the past few years has been almost entirely relocated and rebuilt, bringing it up to the most modern railroad practice. The plan at one time was to have it run



BIRD'S-EYE VIEW OF PANAMA CANAL

This drawing shows the great slides, which have caused so much trouhle in the construction of the canal.

through Culebra Cut on a terrace above the canal, but this scheme was abandoned on account of the slides. It now passes the divide at some distance from the cut and runs along the edge of the lake, crossing an arm on an embankment and reaching the canal again near the locks at Gatun. Originally it ran over land which is now at the bottom of Gatun Lake. From Gatun to Colón it passes through the jungle swamp that presented such difficulties to the original builders, reaching its terminus at Colón.

department food of the best quality is supplied fresh, at prices that would make a housekeeper in the United States envious indeed. Supplies are brought by fast steamer to Colón in cold storage, and transferred immediately to a cold-storage plant which is one of the show places of the Zone. The experience of going from the tropical atmosphere outside to the arctic chill of the storage rooms is very interesting but severe. The variety of the food that one sees is surprising, for there is almost everything that the New York market affords except fresh milk.

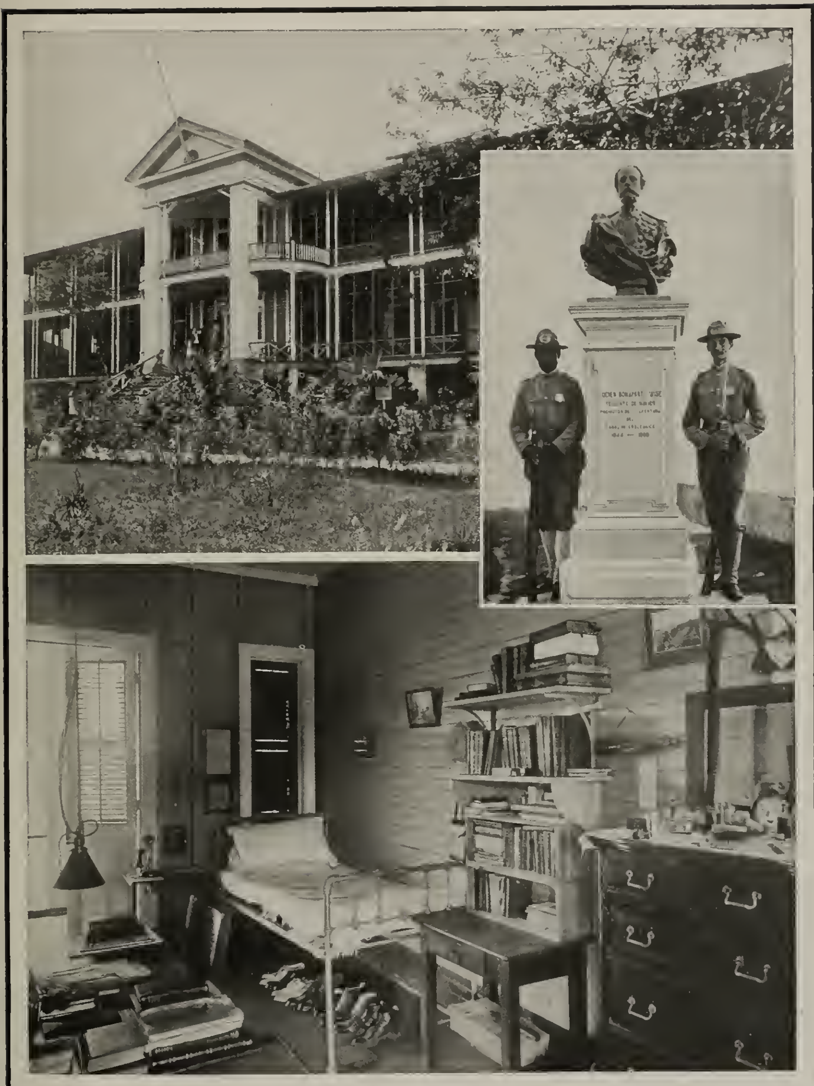
Copyright, Underwood & Underwood

SEEING THE PANAMA CANAL

Uncle Sam runs these sight-seeing cars over the line of the canal for the benefit of tourists.

LIVING CONDITIONS IN THE CANAL ZONE

Steamers touch at Colón bringing men and supplies to the organization on the Isthmus. The aim of the commission has been to make its employees contented by giving them the best of everything at moderate prices, making living conditions here as much like their own country as possible, and paying a high rate of wages. Houses for the married people and quarters for the bachelors, all built of a special type of construction adapted to the tropics, are furnished at low rentals, and by means of the commissary The evaporated milk that comes in cans is used chiefly. If you are there in an "R" month, you may see an attendant pick a quart of oysters from its container and balance it on the end of his finger, frozen stiff of course. Every morning a cold storage train leaves Colón and distributes the products along the line of the railroad to the division stores, where the canal employees can get what they wish. We are apt to think of the canal as a wonder of stupendous cuts and dams and locks, but it is more than that. It has been and is a marvel of organization, and the care and completeness with which this



Copyright, Underwood & Underwood

LIFE IN THE CANAL ZONE

Left top: Gorgona Y. M. C. A., showing characteristic Canal Zone architecture. Right top: Bust of Lieutenant Wyse, who made some of the surveys for the original French canal. Bottom: A bachelor's quarters.

Copyright, Underwood & Underwood

TYPES OF ARCHITECTURE ALONG THE CANAL

The top view shows Gorgona, one of the principal towns along the canal. The bottom view, with the laborers' cottages in the foreground, shows the canal excavation near the end of Culehra Cut and the great Cucaracha Slide, looking toward Pedro Miguel.

Copyright, Underwood & Underwood

VIEWS IN THE CANAL ZONE

Top: Bird's-eye view of Panama City. In the foreground is the high-pressure reservoir for fire protection. Bottom: Locks at Pedro Miguel. Note the side-by-side arrangement.

is worked out are well exemplified in the commissary department.

With the completion of the construction work, the population on the Isthmus decreased rapidly, for a comparatively small operating force is able to work the canal easily. As far as possible the Zone is to be cleared of inhabitants and allowed to grow up again to a tropical jungle, for under these conditions an invading force would have difficulty in molesting the works. At Gatun is the power station which, taking water from the lake, generates the electric current that lights the canal and operates its machinery. At Balboa are the repair shops and also the storehouses where ships may replenish their supplies and equipment, for the government will become a storekeeper on a large scale. Uncle Sam will continue to be an innkeeper, for the great hotels at Colón and Panama will be kept open for the benefit of visitors. The trip through the canal occupies a long enough time for travelers to leave their ships at one end, spend the night at one of the hotels, see the sights of the Zone, and take the Panama Railroad to the other end in time to get their boat. If we compare the pleasure of crossing the Isthmus of Panama now with the terrors of that journey but a few years ago, we must feel that surely the world advances.

THE JUSTIFIABLE PRIDE OF AMERICANS IN THE CANAL

The twentieth century for the United States has begun with the successful completion of a magnificent work, an undertaking that is bound to revolutionize the trade routes of the world and to bring prosperity into many lands which have previously had a hard struggle. We have reason to be proud of it not only because we Americans have completed a difficult task, but because we have put our time and brains and money into a work which is more than a national enterprise, more even than a benefit to a continent — an aid and a benefaction to the whole earth. Well may we be proud of the New World spirit which has given the world the Panama Canal!

PANAMA CANAL STATISTICS

Length from deep water to deep water (miles)	50
Length from shore line to shore line (miles)	40
Bottom width of channel, maximum (feet)	1000
Bottom width of channel, minimum, 9 miles in Culebra Cut (feet)	300
Locks in pairs	12
Locks, usable length (feet)	1000
Locks, usable width (feet)	110
Gatun Lake, area (square miles)	164
Channel depth (feet)	45
Excavation, estimated grand total (cubic yards)	232,353,000
Excavation by French (cubic yards)	78,146,960
Excavation by French useful to present canal (cubic yards)	29,908,000
Value of all French property	$42,799,826
Concrete, total estimated for canal (cubic yards)	5,208,800
Time of transit through completed canal (hours)	10 to 12
Time of passage through locks (hours)	3
Estimated total cost of canal	$375,000,000

(From the Isthmian Canal Commission's "Official Handbook of the Panama Canal.")

THE GREAT MISSISSIPPI DAM AT KEOKUK

Top: Completing the last section of the Illinois coffer dam, July 20, 1912. Bottom: The coffer dam resisting the ice jam of March 24, 1912, which threatened to destroy the work of months, and tested thoroughly the strength of the dam and its ability to withstand any assault of flood or ice. This was one of the worst ice jams ever known on the river, and the sight was dazzlingly beautiful.

OTHER MARVELS OF MODERN ENGINEERING

TUNNELS AND SUBWAYS — WATER-SUPPLY SYSTEMS — IRRIGATION — WATERWAYS — WATER-POWER DEVELOPMENT

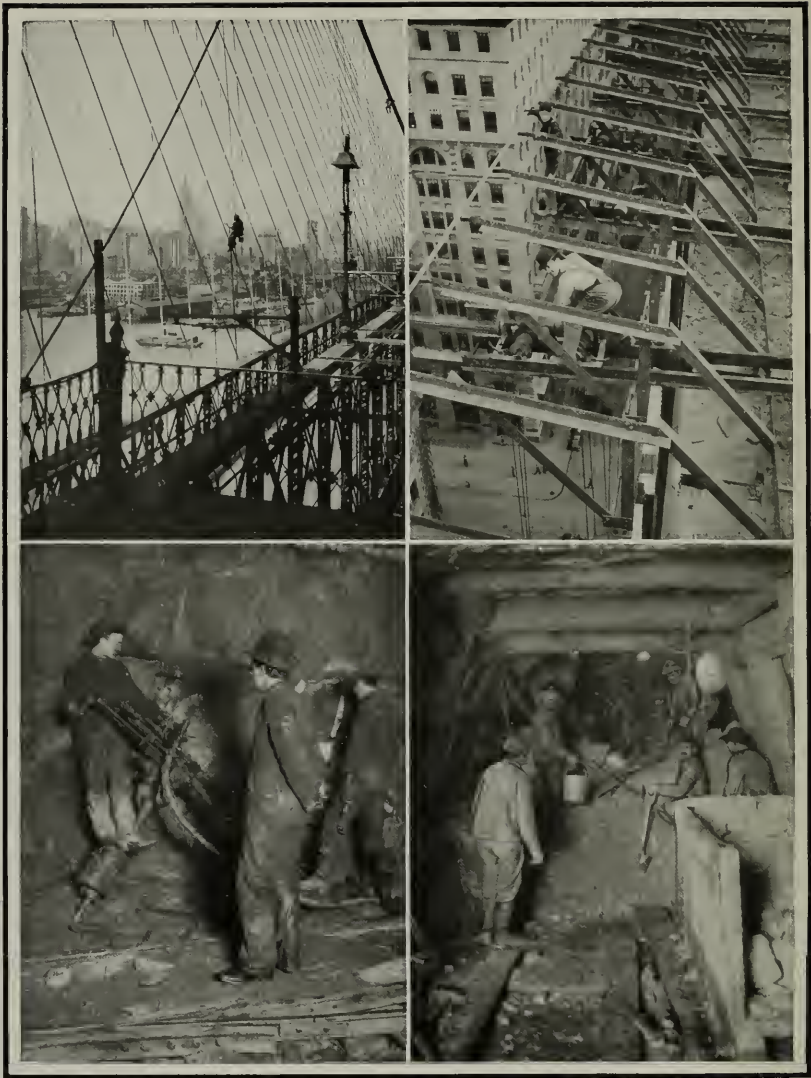
EARLY in the nineteenth century Tredgold, a great English engineer, defined his profession as "the art of directing the great sources of power in Nature for the benefit and convenience of man," a thought so true that it has become classic. What greater field for man's effort than this? Here we live on this earth, surrounded by stupendous powers, avoiding some to escape being crushed by their action, controlling others to do our work, striving always to broaden our knowledge and bring these forces more and more under our yoke. Engineering has accomplished many of the wonders of the last half-century, bringing into bondage to man those great forces of earth, air, fire, and water, a group so awful and so all-embracing that the ancients believed them to be the elements, out of which all things were made.

PROGRESS IN THE CONTROL OF GREAT FORCES

One of man's first wishes must have been to control the earth, but his efforts were puny indeed. If he wanted to reach the country on the other side of a mountain range, he crossed a pass; to get to the opposite side of a valley he scrambled to the bottom and then laboriously climbed the hill. How different it is now, when he is undaunted by the huge excavation of a Culebra Cut, the difficulties of tunneling a mountain range, or the heaping up of a great embankment! Even the daring proposal to build an enormous wall of earth across the Grand Banks of Newfoundland, and in this way completely change the climate of the whole Atlantic seaboard, seems within the realm of possibility.

For a long time man was baffled by the air. Then suddenly came the inspiration to make the power of the wind do his work, with such results as the draining of a whole country by means of windmills. To fly like the birds was for centuries his dream, realized at last in the invention of balloon and flying machine. To the men of early times fire was one of the most unmanageable servants. When wanted it might refuse to work, and if, after much coaxing, they did get it started, it might get so warmed up to its job that it would swallow everything. Gradually man has learned to guide this wonderful force, making it serve him by producing power when and where he wants it. Though his attempts at control even now are sometimes failures, and in spite of his fire engines a whole city is occasionally destroyed by one disastrous conflagration, a glance at the biography of this servant will show how much it is under the influence of the engineer.

To have water where and when he wanted it must have been the cause of much of the prehistoric engineer's work. Though he had to have it for drinking, for bathing, and for watering his primeval garden, yet he did not want it dripping on him through his roof or picking up his house and carrying it away on its flood; and thus the struggles of man to control water, to provide it for his personal use, to arrange canals to carry it and machines to utilize the power of its fall, are some of the most interesting chapters in the history of modern engineering.



FROM THE SKIES TO THE DEPTHS — SOME WONDERS OF MODERN CONSTRUCTION

Top (left): Trusses and cables of the Brooklyn Bridge; (right): Structural ironworkers building the cornice of a skyscraper. Bottom (left): A rock drill in the New York Subway; (right): A heading in the Pennsylvania tunnel. Note the heavy timbering.

Copyright, Underwood & Underwood

A TUNNEL UNDER THE HEART OF NEW YORK

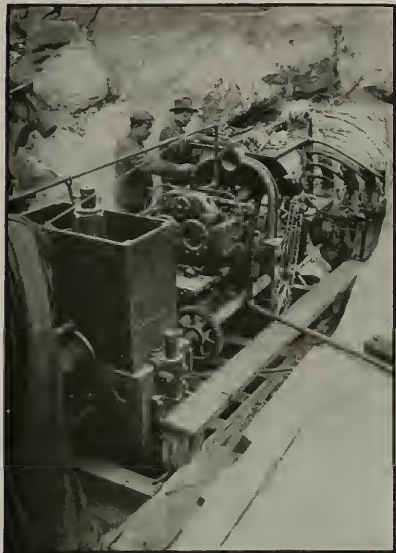
TUNNELS AND SUBWAYS

IN his attempts to get about the globe more easily, man has conquered the earth in many interesting ways. It is important to understand that what we usually call "earth," or "soil," is chiefly the result of the action of weather on rocks. Originally the continents were masses of rock, but the action of rains, streams, and frost has chipped and split, ground and scraped, their hard surface until, with the millions of years since the world began, the rock in many places has become covered with material formed out of its own destruction. This blanket of sand, clay, gravel, or mud always has beneath it at some depth the original ledge. So the problems of conquering the earth are problems not only of digging away soil but also of blasting rock. Some of the greatest feats of engineering have been along the line of arranging passageways under the streets of cities and beneath rivers and mountains.

EARLY TUNNELS

One of the first tunnels of which we have record was built by King Hezekiah at Jerusalem, about 700 B. C., in connection with a water-supply project. It was about two or three feet wide and from six to ten high, while its length was almost one third of a mile. The water-supply system of Athens also included a tunnel, built about 625 B. C., which was about eight feet square and a mile long. A Roman tunnel at Naples is almost a half-mile long, and another in the interior of Italy, built to drain a lake, was bored for three miles through the hardest of rock. It dated from about the first century A. D. On this continent a tunnel was built in 1608 to drain the plateau on which the city of Mexico stands. It was later destroyed by a flood and then dug out to make a deep, open cut.

The entrance of railroads into the transportation business, with their demands for low grades, gave an impetus to tunnel build-



Copyright, Underwood & Underwood

A TUNNEL BORER

An eighteen-foot mechanical mole that eats its way through rock, stone, and sand.

ing, but in the old days when gunpowder was the only explosive known, tunnel construction in rock was a formidable undertaking. In 1854 the famous Hoosac Tunnel in Massachusetts was begun and the work carried forward spasmodically for over twenty years before the completion of its four and three quarters miles of rock excavation. Financial aid was granted by the state of Massachusetts, and the total cost was about twenty million dollars.

ALPINE TUNNELS

In Europe the Alps form a natural barrier between the nations about Switzerland. Intercourse was carried on by circuitous routes and by difficult passes over the mountains until the pressure of commerce became great enough in 1875 to start France and Italy on the Mt. Cenis Tunnel. The magnitude and difficulty of the undertaking were well appreciated, as the contract for the work allowed twenty-five years for the completion of the seven and one half miles of boring. Work progressed slowly until the introduction of rock drills operated by compressed air; but with this improved machinery the tunnel was finished in about thirteen years. The remarkable accuracy of the engineering work is shown by the fact that the two halves joined at the center with almost no error.

Another great Alpine tunnel, the St. Gothard, was begun in 1872, the work on its nine and one third miles being completed in 1880. These wonderful borings are made so long because they must enter the mountain below the snow line. In the case of the St. Gothard, there is over a mile of mountain above the tunnel at the highest point of the bridge. Such great depths make it necessary to drive the "headings," as they are called, from the ends only. Where tunnels are built under lower mountain masses, like the Hoosac Tunnel, for example, vertical shafts are driven from the top of the mountain down to the level of the tunnel. From the bottom of these pits headings are started in both directions as well as from the ends, until adjacent ones meet and the tunnel is done. Not only was the St. Gothard Tunnel itself a difficult task, but the railroad approach up the steep valley is a marvel of construction. In several cases a spiral or corkscrew tunnel had to be driven into the side of the mountain, through which the train runs, all the time on upgrade, bending deep into the vitals of the cliff and, constantly curving, appearing again many feet above the point where it entered.

Soon after the St. Gothard Railway was opened trains began to pass through the Arlberg Tunnel. The builders of this work, learning from the experience of their predecessors, were able to complete its six and three fourths miles at a rate of progress about four times as fast as the Mt. Cenis and at about half the cost per foot.

The St. Gothard remained the greatest of all until 1905, when, after seven years of terrific struggle, the Simplon Tunnel was completed. This magnificent work consists of two parallel single-track borings, each twelve and one third

Copyright, Underwood & Underwood

THE ST. GOTHARD RAILWAY AT ENTRANCE TO THE ST. GOTHARD TUNNEL

The railway enters the mountain on a level with the bridge in the foreground and emerges into the open air again farther up, to plunge into the tunnel once more a little farther on in its route.

miles long, burrowing under the Simplon Pass at a depth of seven thousand feet. It is interesting to notice that this tunnel was opened just a century after the dedication of the famous roadway built by Napoleon over the pass in 1805. Only one of the twin tunnels is now in use, as the traffic has not been great enough to warrant finishing both. Trains meet and pass on a siding about halfway through.

ACCURACY OF TUNNEL WORK

The engineering work on these tunnels is marvelous. To start with, the most accurate surveys must be made over the mountain range between the two portals in order to know the exact direction in which to begin the boring. When one realizes that allowance must be made in these measurements for the sideways attraction of a mountain on a plumb bob in the valley, one can understand something of the infinite pains that even the preliminary work requires. The Simplon measurements were made so carefully that the two headings came together with an error of eight inches sideways and three and one half inches up and down. So accurate was the allowance made for the curvature of the earth that the error in length was only one half inch in over twelve miles.

The work is usually carried on in rock by boring ahead of the full-size hole with a small tunnel in which a gang of men can work, excavating to the final size. If necessary, a lining of brick, steel, or concrete is put in to hold up soft rock or keep out water. Springs, both hot and cold, hindered the work on the Simplon Tunnel, and the problem of ventilation offered great difficulties. Tunnels are usually built so that they slope gently from both ends up to a summit at the center, thus arranging for the drainage of any water that may leak into them.

SUBMARINE TUNNELS

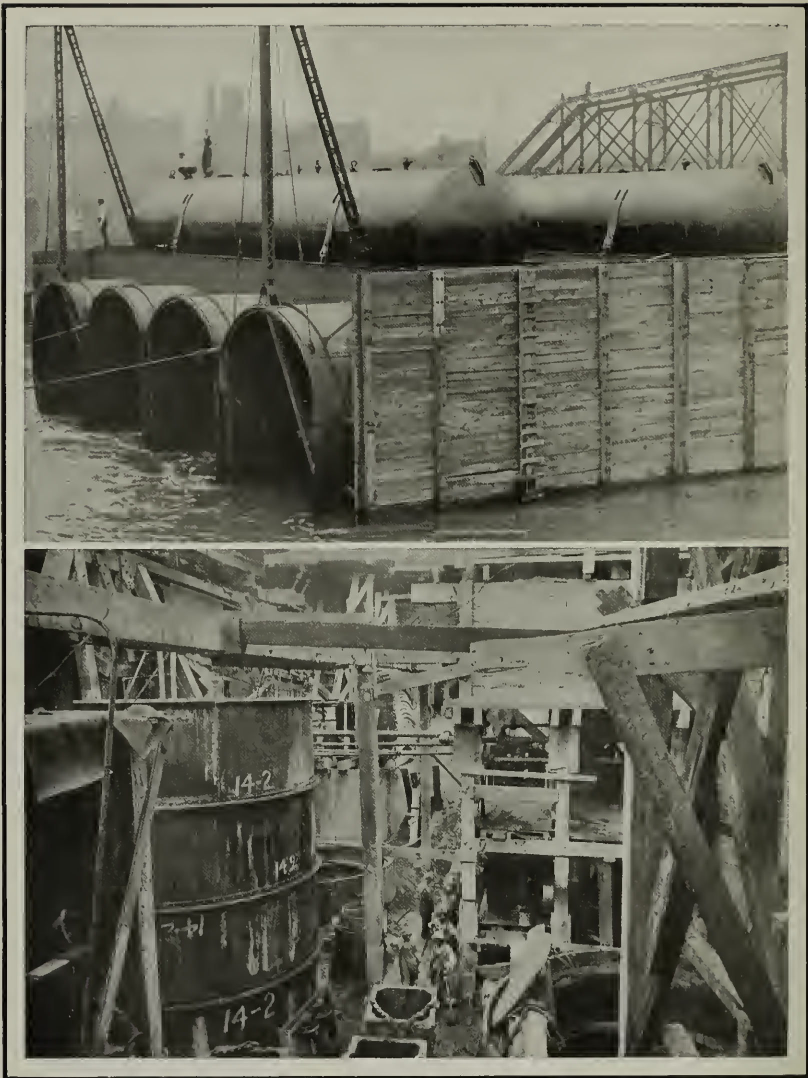
Tunnels are as often required by water as by land, though the problems of submarine and of mountain borings are very different. The latter usually pierce hard rocks, which offer great resistance to working, while the submarine structure must often be built through layers of soft mud and sand. The water which threatens to drown a tunnel under a river may be from springs in the bed itself or from the stream above. In any case it must be kept down to avoid flooding the works, and this is done either by pumping it out at the ends as fast as it flows in, or by closing the end of the tunnel and forcing in air under high pressure, thus holding the water back and enabling men to drive the tunnel farther and farther under the river. If the bed of the stream is rock, the work is carried on by much the same methods as those used in mountain tunnels, except for the difficulty of keeping out the water which leaks in through cracks and veins in the ledge. After the hole is excavated, a water-tight lining of concrete or cast iron is put in. If the river bed is soft, a different method is adopted. A shaft is sunk on shore to the tunnel level, and in this is built a strong metal structure somewhat like the top of a baking-powder can, the diameter of which is a little larger than the finished tunnel is to be. This cap or "shield," as it is called, has doors in the face which corresponds to the outside of the can top, and has strong hydraulic jacks placed horizontally at its rear, by means of which it can be pushed out along the axis of the tunnel. When it is forced against the material of the river bottom and the doors are opened, the earth is pushed back into the tunnel through the openings, thus allowing the shield to move slowly forward. As it progresses, the lining of the tube is built up closely behind it, often of cast-iron segments which give the jacks a solid backing to press against. Sometimes, if the bottom is very soft, the doors are kept closed and the shield is simply forced through the mud, pushing this aside as it goes and not requiring any excavation at all. The tube is kept in line as the work progresses by varying the pressures on the different jacks and thus directing the movement of the shield.

Submarine tunneling began in England early in the nineteenth century, and by 1843, after eighteen years of difficulty, a subway for foot passengers was completed under the Thames at London. Many others have since been built, but none are more remarkable than this, constructed as it was in an age of crude

Copyright, International News Service

VIEWS IN THE HUDSON TUBES, BETWEEN NEW YORK AND HOBOKEN

This important engineering work was put through by William G. McAdoo, afterward Secretary of the Treasury under President Wilson. The system of tunnels is sometimes called the "McAdoo Tubes."



SUBMARINE AND SUBTERRANEAN ENGINEERING

Top: Tubes for the New York Subway before being sunk to the bed of the river. Bottom: Foundation caissons for the Woolworth Building, which carry the weight of the structure down through the soil to bed rock.

machinery and before the dawn of the electric lamp. In 1886 the great Severn Tunnel, about four and one third miles long, was completed. The work on this also was attended with great dangers. Much difficulty was experienced from springs which had their origin below the river bed, and, after one of the many floodings of the works, the laborers were rescued by lowering a boat into the end shaft and poling it along the partly filled tube to a narrow shelf where the men were marooned. Many proposals have been made for tunneling the English Channel between England and France, and the work, though twenty-three and one half miles long, offers no particular engineering difficulties that can be foreseen, except possible cracks in the chalk rock and the problem of ventilation. Its construction seems remote, however, for it would be an international enterprise between countries whose future relations are not by any means certain.

NEW YORK'S TUNNELS

On this side of the Atlantic, New York stands preëminent in number and length of submarine tunnels. Most of these are for the use of railroads, as would be expected, while the others are for gas and water, there being no highway or foot passages. Situated as the city is, between the Hudson and the East rivers, there came a time in its growth when transportation facilities were demanded under or over these streams. Bridges but partly fulfilled the requirements, for it would be difficult to lift an underground railway up to the level of one of these great structures. Therefore engineers naturally turned toward submarine tunnels as the way out. The first one was completed through the soft mud of the Hudson River in 1903. Construction on it had begun thirty years before, but difficulties both financial and engineering had held it up until this last successful push. It was soon paralleled by another tube and the pair duplicated in the lower part of the city, while two others were pushed from the Battery through the fissured rock of the East River to Brooklyn. All these are operated by rapid-transit companies, but the Pennsylvania Railroad, in connection with its magnificent station in New York, soon afterward built two tubes 6118 feet long under the Hudson River, and four others 3900 feet long under the East River, as part of its system. All these are single-track tunnels.

Many interesting problems were solved in the construction of these great tubes. In the case of the Pennsylvania East River tunnel much difficulty had been experienced with the compressed air from the work blowing out into the river, which in some places was separated from the lining by less than seven feet of quicksand. This trouble was much lessened by dumping clay into the river along the line of the work, thus forming a blanket through which the air could blow only with difficulty. Such "blowouts" made work in the Battery tunnel very dangerous, for if much air were to escape, the pressure would be lowered enough to admit water and perhaps drown the laborers. When one of the blowholes would start, something must be stuffed into it at once to stop the rush of air, and if nothing were at hand the workmen would use their arms until something else was brought. One day a man pushed his arm into a blowhole, when suddenly the whole mass blew out, taking him with it up to the bottom of the river, where he rose to the surface and was rescued by a passing boat.

SUBWAYS AND TUNNELS

The term "subway" in its modern use is applied principally to the tunnels which are being built in our great cities to accommodate rapid-transit trains and thus decrease the congestion of travel in the streets. They differ from tunnels in that the latter are built to get under something — a river, perhaps, or a mountain — while subways are built as a matter of expediency, for the better handling of traffic. Their problems of construction are usually simple, for they are built under city streets by the "cut and cover" method. A street is closed either partly or wholly and an excavation made of the required depth and width. Floor, walls, and roof are then laid and the earth filled in on top to the street grade. Then the paving is reset and the street reopened.

The engineering problems of subway con-

struction are not usually very difficult, though street traffic, sewers, conduits, pipes, and nearby building foundations often make them complicated and delicate. The great problems are usually the practical ones of getting the franchise on favorable terms and financing the enterprise.

MODERN SUBWAYS

In most of our modern cities, subways are replacing the older form of rapid-transit structure, the noisy, ugly elevated railroad. In Europe, London and Paris are foremost in developing the underground railway. In the United States, Boston about 1895 worked out a difficult question of surface-car congestion in busy streets by the aid of a short subway, which has since been extended and connected with new rapid-transit tubes to form a very comprehensive and satisfactory scheme. The New York subway system is the greatest in America, both present and prospective. This, for the most part, is of "cut and cover" construction, though in the upper section of the city the less expensive, steel, elevated viaduct has been used. A large part of the subway is arranged with four tracks, so that both express and local trains, the length of which varies from six to ten cars, are run at frequent intervals. This subway is owned by the city and leased to a private operating company.

It is likely that the coming years will see a widely increasing use of subways, for most city people gladly pay the price of their small discomforts for the sake of the speed in travel which they give. A properly designed subway system gives a city a new set of arteries through which its lifeblood may course at greater speed than before, quickening its pulse and aiding its rapid and healthy growth. These underground ways furnish a striking example of man's control over the earth and its effect on civilization.

Copyright, Boston Photo News Co.

A STATION IN THE COMPLETED SUBWAY, NEW YORK

The down-town terminus of the local trains, City Hall.

Copyright, Boston Photo News Co.

RUINS OF THE CLAUDIAN AQUEDUCT, ROMAN CAMPAGNA

The different layers of masonry which may be seen above the arches represent additional channels built by succeeding emperors to increase the capacity of the aqueduct.

WATER-SUPPLY SYSTEMS

THE wonders that have already been told in Volume II of man's control over air and fire are not more marvelous than his command of the forces of water on this globe. His present powers, by which he makes it fulfill the wants of his thirsty body, water the gardens of the world, carry his ships, and turn the wheels of his mills, are the results of long centuries of strenuous effort and much hard, persistent labor.

We can imagine a time when man was so nearly a brute that the problems of clothing and shelter worried him little, but this was not so with the question of water supply. When one considers that the human body is about seven eighths water and that this proportion must be constantly maintained to make life possible, it does not seem surprising that early in his history man turned his attention and effort to making available for his use an ample supply of pure water.

PRIMITIVE WATER SUPPLIES

The thirsty savage made a cup of his hands or of a piece of bark, or flung himself down beside the spring or brook and drank his fill. As he came under the influence of civilization and was affected by its ideas, he began to use more and more of the liquid. It is said that the character of a city may be gauged by the amount of water it uses per person, and it is doubtless as true that the degree of civilization of the savage might have been measured in the same way. Eventually he brought the water nearer to his dwelling that he might have it whenever he wished, and increased the quantity so that at all times he could use it as he pleased. If he were far from a watercourse or spring, he found a moist place in the ground and dug a pit, which, if he were lucky, gradually became filled with water. Such wells were probably the first water-supply works of civilization. The ancients built them everywhere, and some are still famous, like Joseph's

Well at Cairo, which pierces solid rock to a depth of 297 feet.

Great wells, some of which were said to be fifteen hundred feet in depth, were early dug by the Chinese. Many are found in Greece, and we know how frequently mention is made of wells in the Bible. Their simplicity of construction commended them in those days as it does in country regions now, and anyone who has tried the sparkling water from a deep, cold well on a hot summer day can appreciate some of their advantages. They are simply holes deep enough to enter a layer of porous earth which, being saturated with water, acts as a subterranean reservoir and keeps the pit partly full.

Usually the water in wells must be drawn laboriously to the surface, and, moreover, it is not everywhere that a water-bearing layer, or stratum, as the geologists say, may be tapped. The Romans took their supply from the river Tiber and from wells, until, with the city's growth, these sources became so polluted that during the third century B. C. something had to be done. Suitable sources were found in the hills about Rome, and then they built great masonry aqueducts, some of them almost fifty miles long, to bring this pure water to the imperial city. The only materials that were available for their construction were lead, stone, masonry, and earthenware; but Roman engineers had a good command of hydraulic principles, and the works that they installed brought a supply of water that would make

Copyright, Underwood & Underwood

ROMAN AQUEDUCT OF TRAJAN'S TIME, NEAR SEGOVIA, SPAIN

The finest Roman ruin in Spain. Note the superposed tiers of arches, an arrangement that gives a stronger structure than one with a single tier of very high arches.

The LONGEST AQUEDUCT in the WORLD

This great line carries water from the Sierra Nevada to Los Angeles, a distance of about 235 miles. The aqueduct consists of open canal and concrete ditch, covered concrete ditch, tunnels, and steel siphons.

AN ARTESIAN WELL

many cities of to-day jealous. The aqueducts were often carried on long lines of beautiful masonry arches, many of which remain to the present time. The total length of aqueducts in the Roman water-supply system was more than 350 miles.

Not only did the Romans build these great works for Rome itself, but, as they conquered France and Germany and Spain, they constructed aqueducts for the principal cities of those countries. So excellent was their labor that their great arched aqueduct structure at Segovia, in Spain, and a large part of their works at Metz, in Germany, are still in use, although built in the second century A. D.

The Roman system did not supply water to the houses of the people except in the case of the very wealthy. For the most part the water was led into cisterns in the city, from which the people could draw as they needed it. Even at that early day the danger of poisoning from lead pipes was well known, as were the advantages of boiling and filtering.

With the fall of Rome the principles of proper water supply were lost in the general wreck of ancient knowledge, and until about the twelfth century the European world drank water from whatever source might be at hand. A few small aqueducts and waterworks were built during these dark ages, but until the sixteenth century there was little general effort toward improvement. The water used was principally from wells and streams, making pollution of the supply frequent, and there is no doubt that many of the pestilences of the Middle Ages were due to carelessness of this sort. Until quite recent times wells were used in great cities, and some terrible epidemics of typhoid fever have been traced to the fact that a cesspool and a well have become mixed up. The invention of the steam engine in 1765, and its application to pumping machinery, opened great possibilities in the water-supply service of cities, enabling water to be handled with ease and furnished to the inhabitants in ample quantities.

MODERN WATER SUPPLIES

In modern times it is almost universal, in Europe and America, to find careful provision made to supply water to the inhabitants of

cities, and even of towns and villages. Many other parts of the globe are backward, however, notably great cities in the warmer climates, which can least afford the dangers of doubtful quality. Although in the United States the first waterworks were built at Boston in 1652, it was not until the last century that careful attention to water supply became universal. Even at the present time many of our cities are satisfying the demand for ample water without paying enough attention to its purity. Fortunately, with the increasing vigilance of boards of health, this condition is growing less and less common.

The demands of a city for water are not alone for purposes of drinking and bathing and sewage disposal. It is remarkable what enormous drains manufacturing establishments make on its water supply. Boilers must be operated, elevators run, cloth washed, lawns watered, fountains supplied, all usually with water from the city mains. Then, too, the works must be so arranged that they can bring to any point a quantity of water sufficient for fire protection; and this is one of the great loads on any water-supply system.

THE PARTS OF A WATER-SUPPLY SYSTEM

A modern water-supply scheme usually consists of the following parts: a source of supply, works for collection and purification, an aqueduct to convey the supply, and a distributing system to take the water to the places where it is to be used.

The source of supply may be an artesian well or wells, small streams, a river, or a lake. The question of what source of supply a city

Copyright, Underwood & Underwood

THE NEW YORK WATER-SUPPLY TUNNEL

The picture shows the forms for the concrete lining of the pressure tunnel.

shall have is not usually hard to decide, for ordinarily there are not many alternatives. Proper attention must be paid to the adequacy of the supply for future growth in population, and to possibilities of future contamination of the source.

Artesian wells are simply pipes driven down into the ground until they tap a layer of water in the earth or rock. If the pressure is great enough, the water may spurt out from the top; if not, it may have to be pumped. Often dams are built across a number of small streams, collecting their waters and holding them for conveying to a central distributing point. Many cities take their supply from a large river, as does Montreal from the St. Lawrence, or perhaps from a great lake near by, as does Cleveland. When this is done the problems of pollution have to be faced, for many cities above Montreal pour their sewage into the river, and Cleveland uses Lake Erie not only as a water-supply source but also to some extent as a means of sewage disposal. In such cases these polluted sources are used because there are no other adequate supplies available. The danger of disease epidemics must be lessened by artificial purification.

In general, water requires purification because of mud brought down in it, disease germs, or the presence of undesirable chemicals. The methods adopted for purifying it are: either to allow it to stand and let the impurities settle out, perhaps helping the process by first mixing with the water some substance that in settling shall draw them with it; or to filter it by passing it through a thick layer of fine sand. The particular method to be adopted depends on the character of the impurities, but most processes use one or both of the above principles.

When the source of the supply has been selected, the construction of reservoir and aqueduct follows. Usually a reservoir is built near the source, perhaps involving a great dam, in which water can be stored for periods of drought when the supply is meager. From this an aqueduct conveys the water to the neighborhood of the city, and these great artificial streams, since they do not ordinarily follow the natural drainage slopes of the country, are often the great engineering feat of the whole system. At some point near the city another reservoir is arranged, so that if it is necessary to cut off the flow in the aqueduct for inspection or repairs, there will be several days' supply near at hand. From this distributing reservoir, which is usually placed on some height above the city, the water flows into the mains and then to the branching network of pipes which thread the streets and serve the demands of the inhabitants.

WATER SUPPLIES OF AMERICAN CITIES

The waterworks of some American cities are interesting. Boston has provided a pure supply for many years to come, by taking possession of a river valley, making in it the largest lake in the state of Massachusetts, and connecting this with the city by almost fifty miles of aqueduct. The watershed which serves this supply was completely stripped of inhabitants, the work involving the extinction of a whole town. Chicago takes water from Lake Michigan by means of a long tunnel extending to a crib out in the lake. For years the city poured its sewage into the lake from which its people were drinking; but finally, becoming aroused to the situation, it diverted the filthy water into a tributary of the Mississippi River by means of a long drainage canal. The citizens of St. Louis, who drink Mississippi River water a couple of hundred miles below, tried to prevent Chicago from pouring this waste into their supply, but after a long fight the conclusion was reached that a running stream purified itself in course of time, and that St. Louis was far enough away so that the Chicago germs were dead before they reached the lower city.

THE NEW YORK WATER SUPPLY

New York has had a hard struggle to keep her water supply ahead of her population, and system after system was outgrown. Finally, in her last effort, the city undertook to provide a supply that should be adequate for many years to come, by going up into the Catskill Mountains, taking over a great watershed, and building a huge dam and a stupendous aqueduct.

Mr. Charles Strauss, president of the New

York Board of Water Supply Commission, describes this work in the following words:

THE ASHOKAN DAM AND RESERVOIR

"The last stone of the main masonry portion of the Ashokan Dam, one of the largest dams in the world—a masonry structure 190 feet through at the base, tapering to 26½ feet thick at the top, 210 feet above the river bed — was placed on November 10, 1910, three years from the date of the awarding of the contract. Meantime the river was flowing through an enormous hole left in the structure for the purpose, and the extreme northerly wing of the labor army of 3000 men was raising the five miles of rolled earth dikes, with thin masonry core walls 100 feet high, to cut off low arms of the reservoir basin; razing the houses of seven villages, having a population of about 3000; clearing 8180 acres of forests and fields, removing and rebuilding eleven miles of railroad, building forty miles of asphaltum concrete highways and nine reënforced concrete bridges to replace the sixty-four miles of country highways to be submerged; installing gates, valves, screens, and operating mechanisms, etc., with such success that this hole through the dam was closed on September 9, 1912, and the stream began to spread out to claim a new resting place prepared for it, and to submerge the scenes of village and country life of this picturesque valley beneath its hundred-foot mantle of purest sparkling water.

"In the low parts of the valleys massive dikes prevent the waters of the reservoir from overflowing. The Ashokan Reservoir will contain 130,000,000,000 gallons of water, 260 days' supply, at the present rate of consumption of the Greater City.

THE CATSKILL AQUEDUCT

"From the confines of the Ashokan Reservoir the water is led through the Catskill Aqueduct, skirting hills, boring through mountains, dipping under deep valleys, brooking no obstacles in the superhuman endeavor to reach the city at as high an elevation as possible, so that the water will rise of its own accord to the top of a twenty-story building.

"In case of any interruption of the flowage in the seventy-seven miles of aqueduct between the Ashokan Reservoir and Valhalla, near White Plains, there has been constructed a large emergency storage reservoir, called the Kensico Reservoir, capable of holding 30,000,000,000 gallons — sixty days' continuous supply. This necessitated the construction of a large masonry dam across the valley of the Bronx River. This is also one of the largest and highest dams of the world, being 310 feet high, 230 feet through at the base, and tapering to 28 feet wide at the top. The entire aqueduct is about 120 miles in length, from the Ashokan Reservoir to Staten Island, the southern terminal.

THE DISTRIBUTION SYSTEM

"The method of distributing the Catskill water throughout all the boroughs of the Greater City is an engineering innovation, and surpasses that of any other city in the world. It consists of a single circular concrete-lined subterranean tunnel, varying in diameter from fifteen to eleven feet and 18.1 miles long, located in the solid rock at depths of from 200 to 700 feet below the street level. This main artery is connected to the present street mains through twenty-two shafts. . . . From the terminal shaft in Brooklyn water is delivered through two large steel-pipe conduits to the present distribution systems of Brooklyn and Queens. From the end of the southerly conduit the supply is carried across the bed of the Narrows through a thirty-six-inch flexible jointed cast-iron pipe, and is then led to the terminal, Silver Lake Reservoir on Staten Island, at an elevation of 225 feet above sea level.

"The new water system will cost the city, for construction, a total estimated at $141,872,000 for the delivery of the first 250,000,000 gallons per day. The aqueduct and distribution system have been constructed to transport about 500,000,000 gallons per day. The first 250,000,000 gallons daily is obtained from the Esopus watershed, while to secure the remaining 250,000,000 gallons daily it will be necessary to buy the land and to construct the impounding works and connect them to the aqueduct on one or more of the adjacent streams in the Catskills, as contemplated in the original scheme."

Photographs by Brown Bros., N. Y.

VIEWS ON NEW YORK'S CATSKILL WATER SUPPLY

Top: One of the streams that flow to the ocean by way of the Catskill Aqueduct. Middle: A rock-crushing plant. Bottom: Part of the construction plant, showing a power house.

Photographs by Brown Bros., N. Y.

VIEWS ON NEW YORK'S CATSKILL WATER SUPPLY

Top (left): Laying a steel pipe. Note the concrete foundation. Top (right): View of the foundation of a great dam, showing the tubes which carry the flow of the river during construction. Bottom: Views of heavy rock excavation.

Photographs by Brown Bros., N. Y.

NEW YORK'S NEW KENSICO RESERVOIR

Top: One of the bridges required by the flooding of a valley to make tbe Kensico Reservoir. Bottom: The beginning of the great Kensico Dam. The structure at the left is part of the old waterworks.

Courtesy of N. E. Power Co.

SOMERSET AND WACHUSETT RESERVOIRS, MASSACHUSETTS

Top: A view of one of the lakes in the Somerset Basin. Middle: One of the great earth dikes of the Somerset Dam during construction. This dam will create a storage reservoir holding twenty-one billion gallons of water. Bottom: The Wachusett Dam, which, by damming the Nashua River in a narrow valley, makes the greatest lake in Massachusetts.

Courtesy of Northern Pacific Ry.

A STAVE IRRIGATION PIPE IN POSITION

Copyright, Boston Photo News Co.

PRIMITIVE IRRIGATION METHODS IN EGYPT

Note the wheel at the right which raises water from the ditch to the level of the field.

IRRIGATION

PREHISTORIC man probably used the surplus from his crude waterworks upon his garden and thus early discovered the benefits of irrigation, for water is the lifeblood of Nature, as necessary to her well-being as is the blood to our bodies. Without water the earth is a desert, dead. With water it brings forth luxurious growth; the cycle of seed and plant and fruit and seed begins; life is everywhere.

WHY IRRIGATION IS NEEDED

In some favored regions of the earth the distribution of water to the land is ideal. The sun shines on the ocean and by its heat water is evaporated. This vapor, floating about in the air, collects in the form of clouds which are driven by the winds. The amount of water thus held by the air depends on the temperature, for the warmer the air, the more water will be held in it. If the cloud passes into colder air, the vapor condenses and some of it drops to earth as rain, watering the ground where it falls, collecting into springs and swamps, rills and rivers, ponds and lakes, flowing always toward the sea.

But not all parts of the globe are thus favored. Some are so cold that the condensed water freezes and falls in the form of snow, perhaps collecting into glaciers. It may be that great mountain ranges rising to the clouds prevent them from reaching the interior of the land and watering it with their rainfall. Perhaps the continent is so broad that the supply of water in the clouds is exhausted before it reaches the interior. Thus there are many lands where water never falls on the earth as rain. Great rivers may run through them, fed at their sources by brooks or swamps or glaciers; their valleys may be marked by a magic wealth of verdure; but a little way from their banks the desert comes into its own. The sun may shine from a cloudless sky the year round; the temperature is right for the rapid growth of plants; but there is no moisture and all is desolation. The one need is water.

Copyright, Underwood & Underwood

AN IRRIGATION WHEEL

When the wheel is rotated, water is raised to the level of the field in the buckets attached to its rim.

ANCIENT IRRIGATION METHODS

The ancients well knew that it was the magic touch of water that transmuted deserts into gardens. Foremost among them in knowledge of the benefits of irrigation were the Egyptians in the valley of the river Nile. For fifty days at the flood season this river rises above its banks, covering the lands of the valley and depositing over them a layer of rich mud. When the freshet is over the river recedes, leaving this moist fertile deposit ready to spring into life at the sowing of a seed. Farmers of the most ancient times learned to raise earthen banks about their fields, making basins which held the water after the flood subsided, and in this way increased the quantity of the fertile deposit.

But irrigation of this sort has its disadvantages. The flood season comes only once a year, and after one crop has been planted and harvested, the soil lies idle until the next year. The climate is perfect. The land needs only water to make possible the raising of crop after crop. In early times this was accomplished during the rest of the year by carrying water from the river to the fields. Ancient Egyptian carvings of slaves bearing water from the Nile to their masters' gardens show us the primitive methods of these peoples. We who as children have waited on the garden with the laborious watering pot appreciate their difficulties. Soon some genius attached a bucket to the end of a pivoted, balanced pole like a well sweep, and by a series of these raised water to a considerable height. Then came the water-wheel principle, in which buckets were attached to the rim of a great wheel which was rotated by slaves or cattle. As the full buckets reached the top of their path, they were dumped into a trough and the water allowed to run out over the garden. Archimedes lent his great brain to the task and produced the Archimedean screw. This was simply a pipe coiled about an inclined shaft which could be rotated, thus screwing water slowly to the top of the machine.

With all these primitive devices, some of which we find used even now, the quantity of water which could be raised in a given time was so small that the problem of distributing it over the land was easy. But soon man asked why he could not make the river pour itself upon the fields, and he set to work digging ditches to make the river run in upon the land and distribute itself through the soil. This method of irrigation was well known to the Egyptians, for it was not hard to apply in the case of the Nile. This river, strange to say, has so built up its bed by gradually depositing sediment that, for a considerable length of its course, the stream and its immediate banks are higher than the rest of the valley at the sides. If a trench is dug away from the river to pierce this higher bank, it will soon reach a point where it can be made quite shallow and water will still flow through it away from the river. From this main trench it is led into smaller and still smaller channels, finally disappearing by absorption into the ground. So successful was Egyptian irrigation that the land early became of commercial importance as a grain-producing country, holding its place for centuries as the granary of the Roman Empire.

IRRIGATION IN MANY LANDS

The Nile valley was but one of the irrigated countries of early times. Mesopotamia in Asia Minor, the country about the ancient cities of Babylon and Nineveh, flourished wonderfully through irrigation from the Euphrates and the Tigris. The country is now almost a desert, but the ruins of its ancient works give an idea of how great they were. Certain of the canals were more than a hundred feet wide, and at some stages the whole flow of the twin rivers was diverted into the irrigation works. The country needs but irrigation to restore it to its former prosperity, and many plans have been advanced for doing so.

In India, irrigation was practiced in the earliest times. A favorite method of supply, used even at the present, was to build an earthen embankment around a depression in the ground, making a great tank or reservoir, which was filled from wells or by rainfall during the wet season. The stored supply was then used gradually during the dry months. Irrigation in India is to-day carried on extensively by both primitive and modern methods. It is the aim of the government to extend the works more and more, thus lessening the dangers of the frightful famines that have so often scourged the country. Some of the works are enormous. The Periar Dam is a masonry structure extending to a height of 173 feet above bed rock and holding water to a depth of 160 feet.

Irrigation was practiced in Spain by the Moors, who developed remarkable works. Italy's present highly organized system has grown from the irrigation enterprises and methods of the ancient Romans. In Europe, as in other densely populated countries, irrigation is always a necessity, for there are so many people that use must be made of almost every square inch of land. Modern Spain, France, and Italy all have great investments in irrigation works. In Italy, the great Cavour Canal alone carries water a distance of fifty-three miles, over valleys and under rivers, bringing prosperity to nearly half a million acres. This region is one of the most highly developed irrigation projects in the world. The canal and its works are owned by the government, and from small branching channels of the main canal the water is doled out to the farmers.

THE PARTS OF AN IRRIGATION PROJECT

Irrigation works become necessary for two reasons. Either the ordinary supply of water is not sufficient, or it does not come at the right time for the crops, so that means must be provided to supply the water and also works to regulate the quantity. At some seasons the watercourses are full and overflowing, so that the precious liquid runs to waste. At other seasons the streams shrink to mere rivulets, and the irrigation canals, arranged for a bountiful supply, would be dry at just the times when water is most necessary. Reservoirs must be arranged to hold back the surplus at times of flood and let it out gradually during the dry season. A reservoir requires a dam, and this necessity has called into being some of the great dams of the world.

In general, irrigation works consist of a reservoir in which water may be stored, a canal to convey the water to the neighborhood of the country to be irrigated, and branch canals and "laterals," as they are called, which subdivide the water and carry it to the individual's land and the plants. The investigations which must be made before one of these projects is undertaken are often interesting. The flow of the streams which are to furnish the supply must be carefully measured over a period of years; information as to the rainfall, if any, must be gathered; and estimates of the prospective population, character and value of crops, and increase in land values, as well as many other features, must be investigated before conclusions can be reached.

A MODERN IRRIGATION PROJECT IN EGYPT

Some of these modern irrigation projects are stupendous. In Egypt, the birthplace of irrigation, the demand for a constant supply of water throughout the year, in order that several crops might be raised, brought about the construction of the great Assuan Dam, the greatest though not the highest masonry dam in existence. The original structure was com-

Copyright, Underwood & Underwood

THE ASSUAN DAM

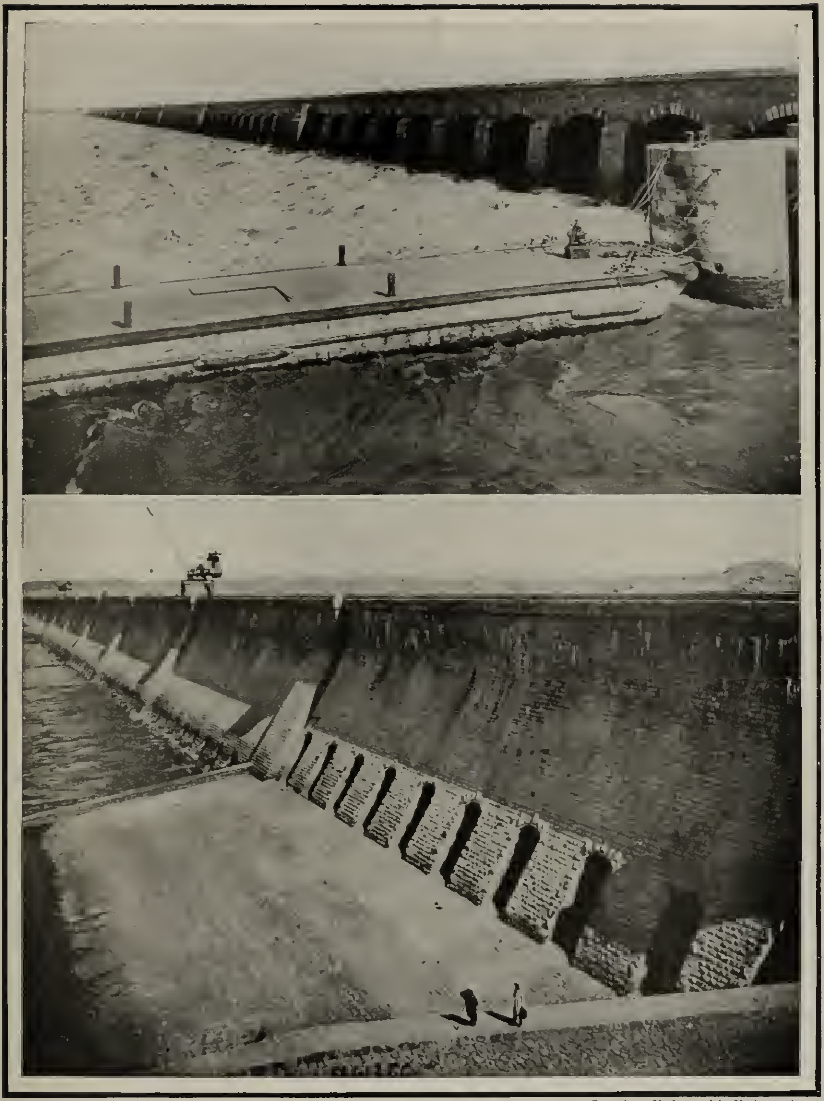
Looking along the structure during the work.

pleted in 1902, after world-wide discussion and protest from archæologists who did not wish to have some of the ruins of ancient Egyptian temples submerged. Their efforts were successful, and the dam as first built was 120 feet high and held back 65 feet of water. The reservoir operated successfully for about ten years, when the dam was increased in height twenty-three feet, thus greatly enlarging the storage capacity of the lake. Instead of allowing flood water to spill over its top, the dam is arranged with openings through the masonry, ordinarily closed by gates, which in freshet times may be opened and the river allowed to pour to waste through these sluices. When the flood begins to subside, the gates are gradually closed, so that the dry season is started with the reservoir full. As the river grows smaller and smaller after the flood, the gates in these sluices of the dam are opened a little at a time and the stored water allowed to run out in such quantity that the river level below the dam never falls under a certain point. Another dam across the Nile at Assiut, about three hundred and fifty miles below Assuan, diverts the water into the great Ibrahimia Canal. The uniformity of flow secured in the Nile by the regulating effect of the Assuan reservoir makes it possible to irrigate the lands served by the canal the year round and thus raise several crops in the twelve months. The effect of the dam was to change the character of irrigation in the Nile valley from seasonal to perennial, with great increases in land values. It is estimated that not over one tenth of the water that enters Egypt by this valley finds its way into the Mediterranean, the rest being evaporated from the surface of the streams or used in irrigation work. Engineers estimate that in an average season a layer of water three and one half feet deep is evaporated from the surface of the Assuan reservoir.

MODERN IRRIGATION IN THE UNITED STATES

The United States is so situated that a great part of its area requires irrigation. When we were a people of the Atlantic coast alone, no provision for artificial watering was necessary; but with the movement of population to the West, its importance soon became evident. The Mormons early converted parts of Utah which they found a desert into a wonderful garden, and their example was followed by a steadily increasing tide of settlers. Irrigation projects were developed in a more or less desultory and spasmodic way until, in 1902, Congress passed the Reclamation Law, which provides for "appropriating the receipts from the sale and disposal of public lands in certain states and territories to the construction of irrigation works for the reclamation of arid lands." The provisions of this act are carried out by a department known as the United States Reclamation Service, organized as part of the Department of the Interior.

When the engineers of the Reclamation Service report favorably on the development of a project, and the Secretary of the Interior decides to go ahead with it, the owners of the land which will be irrigated form themselves into an association to take over, maintain, and operate at their own expense the proposed



Copyright, Underwood & Underwood

EGYPTIAN IRRIGATION WORKS

Top: The Assiut Dam, downstream face. This structure, about 350 miles below the Assuan Dam, diverts the waters of the Nile into the great Ibrahimia irrigation canal, which may be seen in the foreground. Bottom: The Assuan Dam, probably the greatest structure for irrigation purposes ever built by man. Note the sluice openings through which the flood water is allowed to waste.

Photograph by R. A. Turnbull

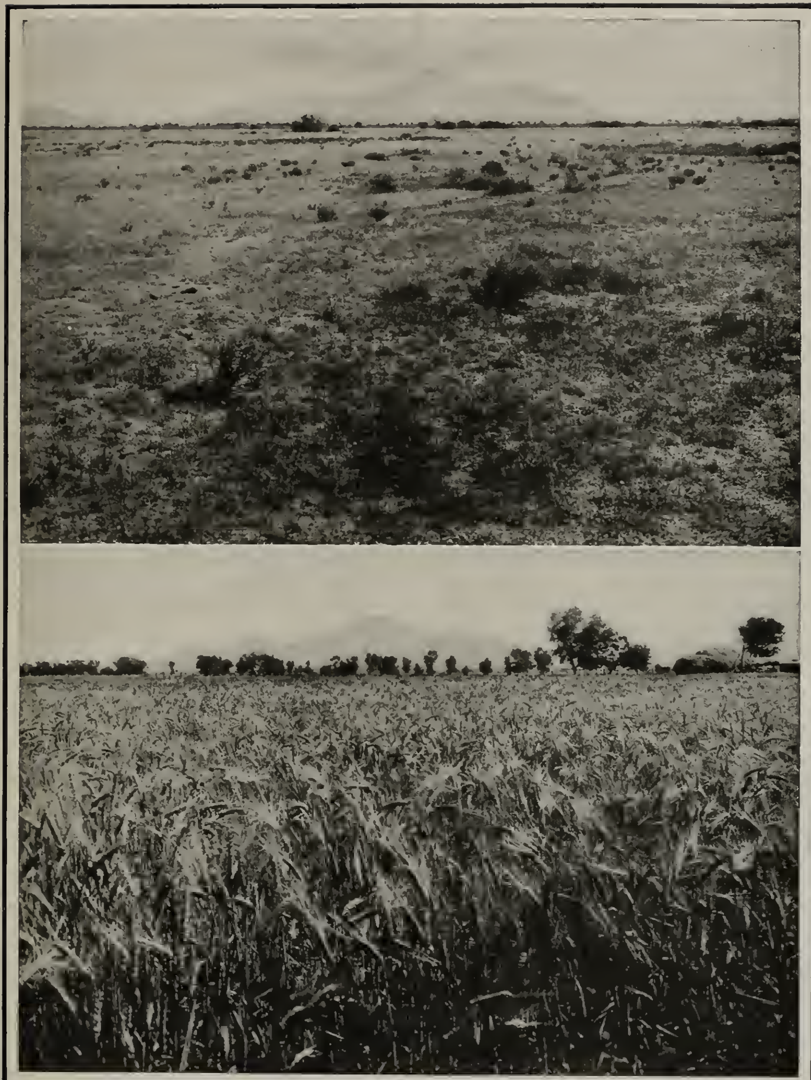
THE ROOSEVELT DAM

The main feature of the Salt River Valley project, Arizona.

works which the government is to build. The ownership of the enterprise itself remains with the government, and the water users' association pledges some of its lands to the United States for the return of the cost of the reservoir and irrigating works.

One of the great works of the Reclamation Service has been the Salt River Valley project in Arizona. The storage reservoir for this enterprise is created by the famous Roosevelt Dam across the Salt River, about fifty miles above Phœnix, the capital of the state. Our illustration shows this magnificent structure on the day of its dedication. It is an arched masonry dam, 270 feet high above the lowest point of its foundation, holding back a lake 210 feet deep at the dam, 20 miles long, and from one to three miles wide. It contains water enough to flood an area of 1,300,000 acres one foot deep.

The site of the dam is a deep cañon, one hundred miles from the nearest railroad and one thousand miles from the nearest coal mine. When the work was first proposed, it was almost impossible to reach the place even on foot, and the engineers had to lay out a long wagon road which was cut from the solid rock. In order to get power for the construction work on the dam, a hydroelectric plant was installed which made the river aid in its own damming. Before the foundation of the structure was laid, a tunnel was driven through the rock at the side of the valley underneath the site of the works, and the river was diverted through this. Then three hundred thousand cubic yards of masonry were piled up to make the beautiful curved wall of the dam, the tunnel was closed by a gate, and the river was allowed to fill the reservoir. Like the Assuan Dam, no irrigation canal starts directly from the reservoir; but during the dry season the tunnel is partly opened and water allowed to pour down the river bed to another dam, much smaller, at a point about fifty miles below. This smaller dam diverts the flow into a canal, by means of which water is distributed to the surrounding country. The area which can be served by this project alone is estimated at two hundred thousand acres. The great head of water at the



Copyright, Boston Photo News Co.

THE SALT RIVER VALLEY PROJECT

Two views, showing land before and after irrigation.

dam is utilized by passing the stream from the reservoir through water wheels, and the power thus generated is carried to other parts of the project and used to pump additional water from wells for irrigating purposes. An undertaking of such magnitude could be financed and constructed by private enterprise only with difficulty, and it is well that these works are carried out by the government.

AN IRRIGATION DISASTER

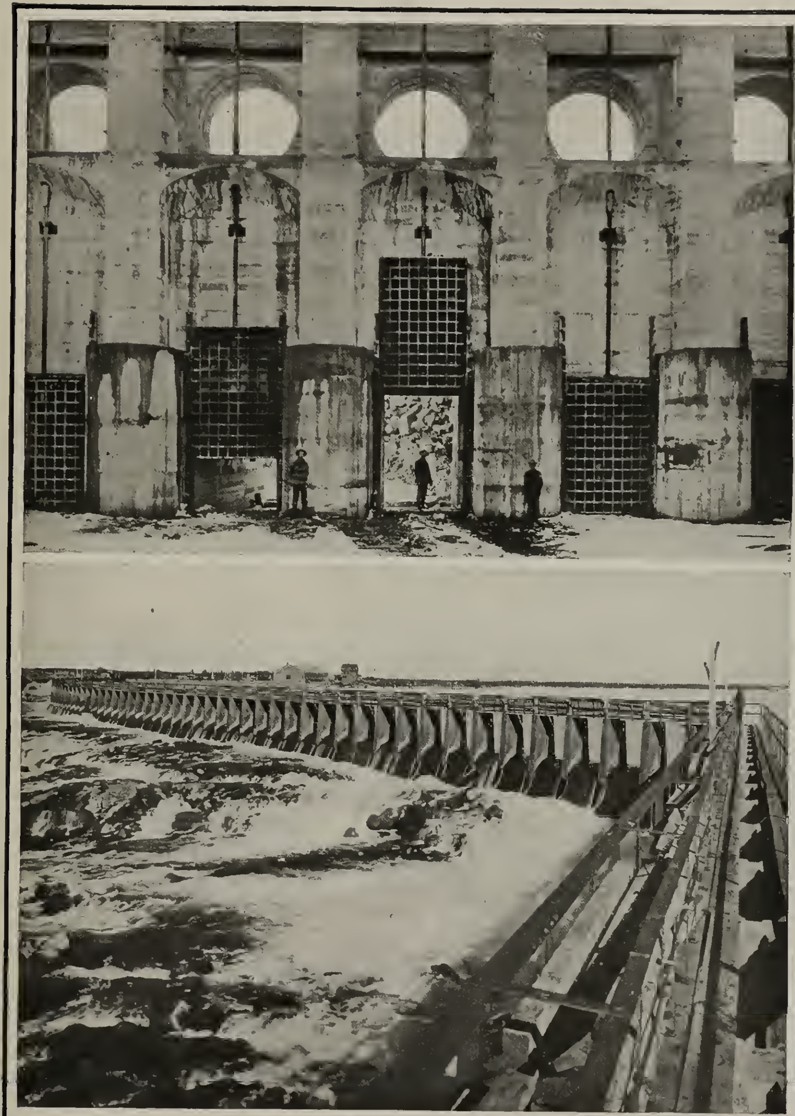
Irrigation projects by private enterprise have given rise to some interesting situations. One recently came about when a great river broke its fetters and for a time threatened to overwhelm whole settlements. The Imperial Valley in southern California is a great depression, ninety miles long and containing a million acres. Into this valley, which geologists say was at one time part of the Gulf of California, flow several small streams, but the valley has no outlet. A strange feature of the place is that, like the Dead Sea in Palestine, its bottom is below sea level — in this case a distance of 287 feet. Near the rim of this huge bowl the Colorado, one of the great rivers of the United States, flows by on its way to the Gulf of California. The inner slopes of the depression furnish thousands of acres of country ideal for irrigation, and there at the edge is the great river, waiting only to be tapped to pour its life-giving water down the valley. The most suitable place to draw from the Colorado was at a point in Mexico near the border, from which the water could be led back into the valley, which lies in the United States. A few individuals formed a company and built a small canal to do this work. The success of the enterprise was immediate, and by 1904 almost ten thousand people were living in the valley, their wants served by a hundred miles or more of railroad.

All went well for a time and the owners of the system rested happily in the profits of their venture, until one spring the head works of the irrigation canal into the valley filled up with mud and cut down the farmers' supply of water. The crops were dying of thirst and something had to be done; so the company dug an additional temporary canal about three thousand feet long, from the river to the old canal, making this new trench fifty feet wide and eight feet deep, but not providing it with any head gates for regulating the flow. The neglect was almost criminal, for the great river immediately began to eat away the soft banks of the makeshift canal and in a short time was beyond the control of the unfortunate company. The managers made ineffectual efforts to close the breach, but in vain, for by 1905 the whole Colorado River was pouring into the depression, submerging everything in its way, and making a new inland sea.

The Southern Pacific Railway was one of the great sufferers. When it was found that the company could do nothing to avert the calamity that was fast overtaking the valley, the railway company took over control of the irrigation enterprise and began almost superhuman efforts to get the situation in hand. After a series of most disheartening failures it finally succeeded in throwing a barrier across the breach and turning the Colorado back into its own bed. The story of this affair emphasizes the unceasing watchfulness needed in the control of these vast forces of Nature.

WORK OF THE RECLAMATION SERVICE

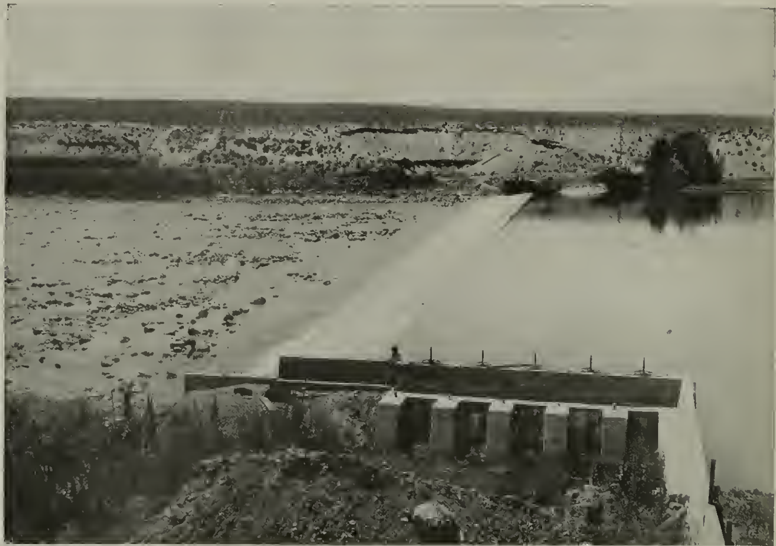
The Reclamation Service has worked out many great enterprises successfully and has many more at some stage of progress. The Yakima River undertaking in Washington was one of the early large projects of this country, and it is said that in five years after its opening the value of land had increased from $15 to $75 per acre. The Truckee-Carson project in Nevada takes from two rivers water which was formerly wasted in dry lakes of the desert, and, by means of a canal 30 miles long, conveys it to a new reservoir, where it is stored for irrigation purposes. The water available is said to be sufficient to serve 300,000 acres. The Minidoka project in Idaho uses the water of the Snake River to make possible the irrigation of 150,000 acres. In two years, more than 4000 people settled on this tract and the sale of lots in the new towns netted the government over $100,000. The Uncomphagre and Gunnison project in southwestern Colorado can serve about 150,000 acres. This under-



Copyright, Boston Photo News Co.

THE MINIDOKA PROJECT DAM IN IDAHO

This structure is 625 feet long and has a height of eighty feet above bed rock.



Courtesy of Northern Pacific Ry.

TOP: YAKIMA RIVER DAM. BOTTOM: MAIN IRRIGATION CANAL OF THE PASCO RECLAMATION COMPANY

Courtesy of Northern Pacific Ry.

IRRIGATION IN THE YAKIMA VALLEY, WASHINGTON

Top: Onions between rows of peach and cherry trees. Middle: Picking raspberries. Bottom: Part of a hundred-acre prune orchard in bloom.

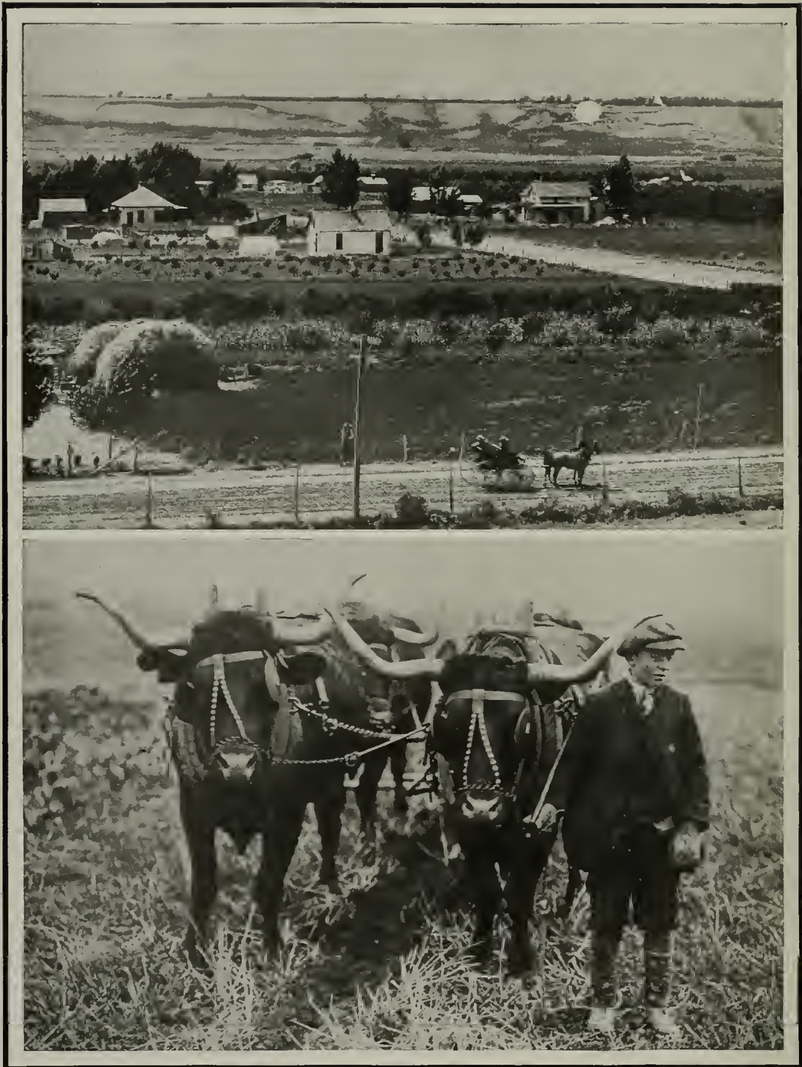
IRRIGATION IN THE YAKIMA VALLEY, WASHINGTON

Top (left): An irrigation flume. Top (right): An irrigation canal. Bottom: Irrigation in a young orchard. Clover is sown between the rows of young trees.

Copyright, Boston Photo News Co.

IRRIGATION DAMS AND CANALS

Top (left): The great Shoshone Dam in Wyoming. Height 328 feet. Note the waste water discharging from a tunnel at the left. Top (right): The Strawberry Valley Irrigation Tunnel in Utah. Length over four miles. It carries water from one valley to another under the Wasatch Mountains. Bottom: A concrete-lined irrigation canal on the Truckee-Carson project in Nevada.



Copyright, Boston Photo News Co.

THE UNCOMPHAGRE PROJECT, COLORADO

Top: Land showing results of irrigation. Bottom: Aids to irrigation.

taking included the construction of a twelve-foot tunnel, six miles long.

Further projects of the Service are many and great, and they are being worked out, not alone with a view to present returns, but to future needs of the country as well. It is fortunate indeed that such great work is in the hands of the government, for the undertaking of labors like these requires not only large means, but also a certain benevolent spirit necessarily lacking in private enterprises.

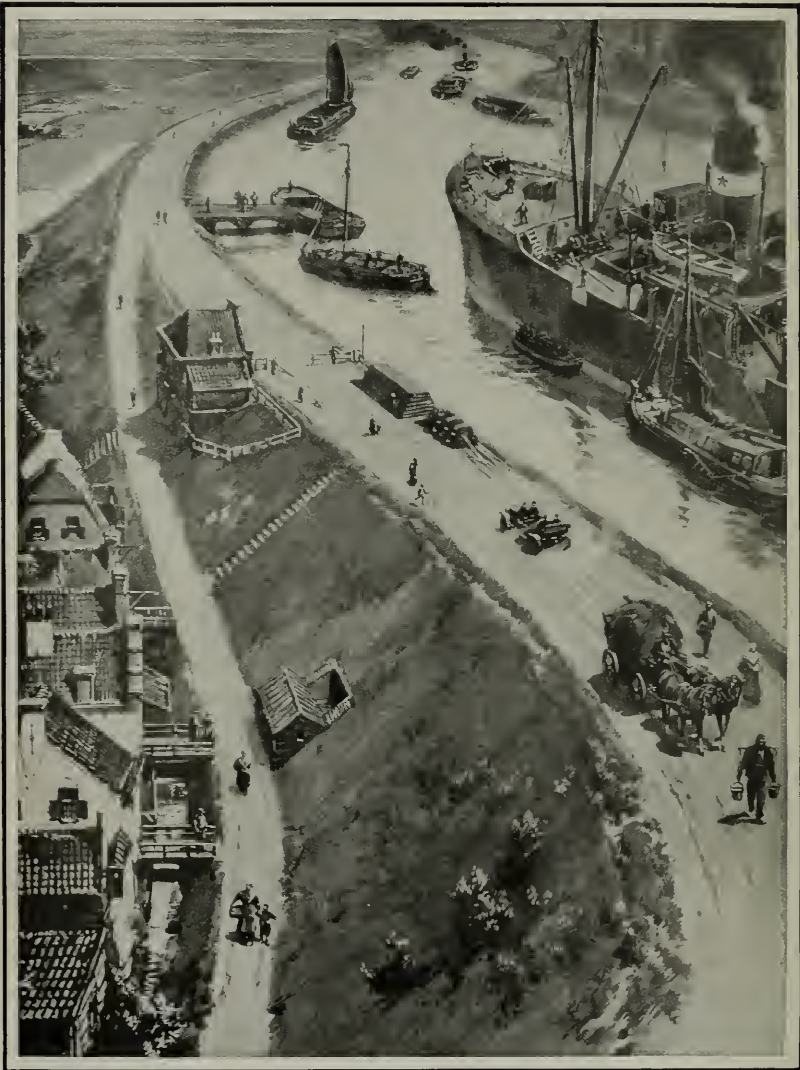
THE FUTURE OF IRRIGATION

With the increase in population, requiring as it does new land for living, and for raising an adequate food supply, new areas are being constantly brought under cultivation, some by draining, but more by irrigation. It is possible by using intensive methods of cultivation to get larger and larger crops from the same piece of land, but after this is carried to a certain point the additional labor does not produce a proportionately larger yield. More land must be had. Population is bound to increase, and the demand for food must increase in proportional quantities. It requires no great imagination to look forward to a time when land that was considered by early settlers to be of little or no value will be highly prized, simply because there is no other available. The deserts must be used, and extensive irrigation works will make this possible. In Europe the necessity for utilizing every available bit of land has long been felt, and this is the cause of the high development of European irrigation methods. It is but a question of time when, in like manner, all the available land of the globe will be taken up, and when the demand of crops from it will require perhaps far more extensive and complicated irrigation works than the world has ever seen.

Copyright, Boston Photo News Co.

THE PATHFINDER DAM

This dam, 218 feet high, holds back the water for the North Platte project in Wyoming and Nebraska. The undertaking includes a distributing canal ninety-five miles long.



A WATERWAY IN HOLLAND

By building these great earth dams to hold back the rivers and the sea, the Dutch have been able to reclaim millions of acres of land that were formerly flooded.

Copyright, International News Service

SHIPS PASSING THROUGH SUEZ CANAL

WATERWAYS

OUR prehistoric ancestor in the most ancient times was familiar with the use of boats on streams and lakes, and quite naturally he used them on the canals that he built for irrigation purposes. He had always been fond of travel by water, for it appealed to his lazy instincts, so from this point it was but a step to the construction of waterways for purposes of transportation alone.

Canals were early built by civilized peoples. The Grand Canal in China dates from the thirteenth century, while in Europe, Charlemagne about the eighth century began a system of canals to connect three great rivers, the Rhine, the Maas, and the Danube. The Languedoc Canal, 148 miles long, which made Spain and Portugal an island, was completed from the Atlantic to the Mediterranean in 1681, a tremendous work for that age. The Romans built canals in Great Britain during their occupation of the country, but the real impetus to waterway construction in that land was given by the success of a canal dug by the Duke of Bridgewater in 1759 to bring coal out from his mines in the interior. The Trent and Mersey Canal, built about this time, passed through a tunnel over a third of a mile long. Great investments were made in these works until railroads began to compete for transportation business, when the several advantages of rail over water transit threw many canals into disuse and stopped the construction of those that were not really needed by the commerce of that time.

Canals are not the only commercial waterways. Rivers, where navigable, form valuable carriers for transporting goods, and in recent times much work has been done to improve shallow and rapid streams, by dredging channels and building dams to make a series of communicating navigable reservoirs. Often these dams are arranged in most ingenious ways, so that in times of flood they can be removed from the stream either partly or wholly.

SHIP CANALS AND BARGE CANALS

Canals as we know them are usually built to provide passage through some strip of land and save a long and perhaps roundabout course, in which case they are called "ship canals," or to furnish a transportation route through a country, in which case they are called "barge canals." The great works at Suez and Panama are examples of the first sort, while the new Erie Canal in New York State stands foremost in this country as an example of a barge canal. The canals of Holland are used incidentally for transportation purposes, but their primary use and real reason for existence are to provide channels into which the water drained from the land may be pumped.

The possibilities of canal construction were greatly increased by the invention of locks, about the fourteenth or fifteenth century. It is claimed by some that Leonardo da Vinci, the great painter and engineer, was the genius who built the first one. A lock, as has already been explained in the chapter on the Panama Canal, is a device for lifting a boat uphill by shutting it up in a box and then pouring water into the box. Previous to this time canal boats had been lifted from one level to a higher one by dragging them up an inclined plane, a method which is used on Chinese canals to-day. Some canals have been built which raise boats from level to level by floating them into a box full of water, which is dragged up along a track to the higher position and then opened into the upper canal. Sometimes the boat is simply rested on a frame or cradle which is drawn up in the same way. Sometimes a box of water in which the boat rides is lifted vertically by powerful jacks to the new level.

The passage of boats between levels takes water from the higher to the lower parts of the canal, and one of the chief demands then is an adequate supply of water, or "feeder," as it is called. Then, too, the canal must be arranged so that if storms and floods pour water into it, the surplus can run to waste without damage to the works. Another requirement of a canal is a way of drawing boats through it. The old plan was to have a towpath beside the waterway, along which men or animals walked with a rope which was tied to the boat. Some canals have been arranged with electric locomotives which run on a track parallel to the edge and do the work of the humble mule; others are constructed with protected banks so that vessels can sail through under their own steam without damage from the wash against the sides of the canal. Boats were propelled through the Trent and Mersey Canal tunnel, already mentioned, by men called "leggers," who lay on their backs on the deck of the boat and pushed with their feet against the roof and sides of the tunnel.

GREAT CANALS OF THE WORLD

Among the great canals of the world, two stand out preëminent, that at Panama, of which you have already been told, and the Suez Canal. When Napoleon took possession of Egypt early in the nineteenth century, he caused surveys to be made for a canal between the Mediterranean and the Red Sea at Suez; but his engineers reported a difference in level of thirty feet between the two ends, and nothing came of the investigation. In spite of the arguments of a famous French mathematician, who disputed the report on theoretical grounds, the difference of level between the seas was not known until 1847, when it was found that the only variation was due to the rise and fall of the tides. After difficult surveys over the hundred miles of desert through which the canal passes, work was started in 1860 under the direction of Ferdinand de Lesseps, the great French engineer. In order to get supplies to the work and also to furnish water to the laborers, a fresh-water canal, 132 miles long, was first dug from the river Nile at Cairo to the port of Suez, a great work in itself. The soil of the isthmus is principally sand and clay, with very little rock, and the canal was completed without great difficulty in 1869 and was opened with a magnificent celebration.

This cut reduces the distance between England and India from 11,379 to 7628 miles, and with such a reason as this for its use, success was immediate. It has been constantly widened and improved since its opening, though even at the present it is what might be called a "single-track" canal. "Sidings" or enlargements are

provided at frequent intervals and their use governed by a block-signal system like that found on a railroad. When two ships are to meet, one of them must tie up to the bank at an enlargement and wait for the other to pass. It was at one time even proposed to "double track" the canal by building another waterway parallel to the original. The greatest care is exercised in working ships in the canal, for accidents are very expensive, blocking, as they might, one of the main arteries of the world's commerce.

Germany has many canals, the chief of which is the Kaiser Wilhelm. This, with its cut of sixty-one miles, connects the North Sea and the Baltic and separates Denmark from the continent of Europe. In Greece, as far back as the time of Nero, the Roman Emperor, a canal was proposed across the narrow isthmus which joins the two parts of that country, and the trial pits dug at that time were used in the preliminary investigation for the recently built canal. Although only four miles long, it is interesting on account of the depth of the cutting necessary. This was 286 feet at the highest point, and for over two and one half miles it was two hundred feet deep.

The most important canal in the British Isles is the Manchester Ship Canal, dedicated by Queen Victoria in 1894. This waterway makes the great manufacturing city of Manchester a seaport, though situated thirty-five miles from the coast. There are four sets of locks, each set consisting of a small and a large lock side by side. Probably the most interesting feature of this work is a swing bridge, which carries the old Bridgewater Canal over the new Manchester waterway. This is a great steel trough 19 feet wide, 6 feet deep, and 234 feet long, which may be closed off from the rest of the overhead canal and swung about an axis so that boats may pass by in the lower canal. It may be opened even with a boat floating in it without disturbing its balancing, for the weight of water displaced is equal to the weight of the boat itself.

A BOAT PASSING THROUGH A LOCK

In the Panama Canal locks, electric locomotives tow boats through, as shown here.

AMERICAN CANALS

The Erie Canal is doubtless the most famous in the United States, and probably it was the greatest single influence in placing New York City in her present position of commercial prominence. It was opened in 1825 between Lake Erie at Buffalo and the Hudson River at Albany, with a depth of only four feet, accommodating seventy-five-ton boats. The capacity was increased several times by comparatively small amounts, but toward the end of the nineteenth century commerce had almost ceased to use it. With the idea of restoring it to the importance of former days, the state of New York has recently reconstructed it as the New York State Barge Canal, on a scale large enough to take three-thousand-ton boats. The new waterway follows the line of the old for the most part, but the old machinery has been everywhere replaced by the most modern devices. Where the old canal laboriously climbed a steep hill at Lockport in a flight of five small locks, the new canal has two great ones with a combined lift of forty-nine feet. The Erie Canal reconstruction is only a part of the extensive improvements in her waterways that are being planned by the state's engineers.

What are said to be the largest locks in the world, except those at Panama, pass boats by the twenty-foot fall between Lakes Huron and Superior at Sault Sainte Marie. The original canal was built about 1855 as a private enterprise. After being enlarged several times, it was taken over by the United States government in 1881 and made a free canal. On the opposite side of the river the Canadian government has a lock, in order that its vessels may pass the falls without entering United States territory.

During the years from 1892 to 1900 Chicago constructed her drainage canal, to divert the polluted water of the Chicago River from Lake Michigan to the Mississippi River watershed. Geologists tell us that at one time all the water from the upper Great Lakes flowed to the sea by this route, but times have changed, for now over $35,000,000 had to be spent on a waterway thirty-four miles long to pour a small part of the drainage of the lakes down its ancient course. The canal was built primarily for sanitary reasons, but incidentally it forms a part of the much-talked-of "Lakes to Gulf" waterway, and also is a power development of enormous possibilities.

Canada has a number of important canals. The rapids of the lower St. Lawrence River

THE CAPE COD CANAL. THE CHARACTER OF THE BANKS

are avoided by a series of waterways, and passage around Niagara Falls between Lakes Erie and Ontario is made possible by the Welland Canal. By means of twenty-six locks this drops 327 feet in its length of $26\frac{3}{4}$ miles.

A project that has had a long history was completed in 1914, when the ship canal across Cape Cod from Massachusetts Bay to Buzzard's Bay was opened for traffic. The dangers of this coast have been feared ever since the Pilgrims first landed on Cape Cod, and the country had not been settled long when it was proposed to dig a canal across this neck. The site is ideal for a waterway, as a natural depression with a maximum height of twenty-nine feet above sea level extends the whole eight miles. Notwithstanding its simplicity, the project hung fire for forty years after the first real start, and it was not until 1909 that the work was begun which was to finish the job. It shortens the distance by sea between New York and Boston by sixty-six miles.

CANALS OF THE FUTURE

Waterways have been proposed across Florida from the Atlantic to the Gulf of Mexico, along the Atlantic coast, from the Great Lakes to the Gulf of Mexico, from the St. Lawrence River to Georgian Bay in Lake Huron by way of the Ottawa River, and in many other places. It is very doubtful if there are many of these which would ever justify themselves by saving on transportation costs, as the possibilities of inland water shipment to any desired point are so few. Therein lies the strength of the railroad. A merchant in any city can ship goods by rail directly to any other point by loading them into a freight car and billing them through. With canal transportation, unless both cities are on the waterway or one of its few branches, the goods must be unloaded and reloaded, with the consequent dangers of delay and breakage, not to mention expense. With great staple products like coal and grain and ore, traveling along well-defined routes, water transportation may be economical, but it is doubtful if there is business enough of this sort to justify the great estimated expense called for by many of these proposed waterways.

Most canals must compete with railroads for business, and their stupendous construction costs must be justified by the cheapness and convenience of their service. The most necessary canals on the globe, those at Panama and Suez, have been built. No others can compare with them in importance, for by parting continents they change the trade routes of the world.

SHOWS HOW EASY WAS THE WORK OF EXCAVATION

POWER HOUSE OF THE MISSISSIPPI RIVER POWER COMPANY, AT NIGHT

WATER POWER

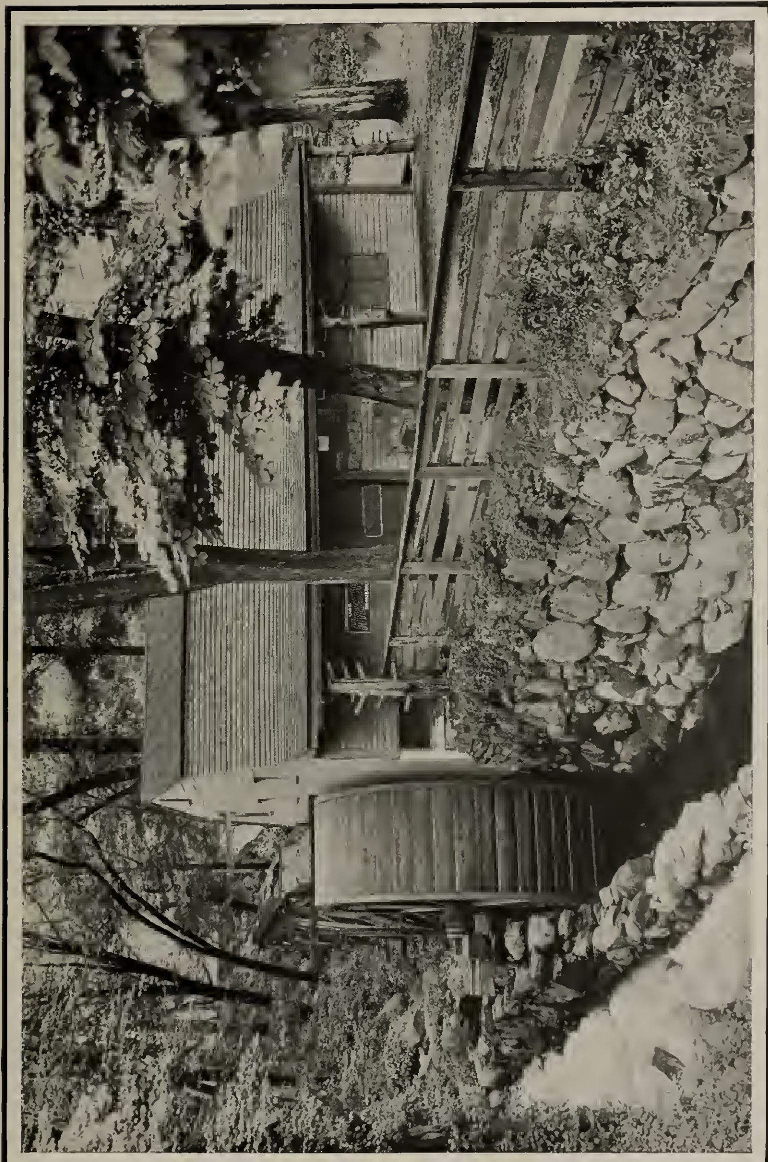
MARVELOUS as are the ways in which man directs the forces of water for his consumption and his transportation, his command over the power which exists in a flowing stream is still more wonderful. The last few years have witnessed a great extension of his control of water powers through his increasing knowledge of the possibilities of transmitting energy by electricity, but his use of the force in moving water began centuries ago. The name of the builder of the first water wheel has been lost in the distant past.

EARLY METHODS OF USING WATER POWER

Probably the principle first used in developing water power was the tendency of a flowing stream to carry anything down with it. Therefore if a wheel was arranged with paddles on the rim and placed so that the bottom just dipped into a moving water surface, the wheel would be turned and the power could be utilized. Such a machine uses only the energy due to the water's velocity, and in modern times is termed an "undershot wheel." Soon man learned to put his wheel at a place where there was a drop in the stream bed, and to use cups or buckets instead of paddles on its rim. The water was led to the wheel at some point higher than the bottom, and not only pushed the wheel around because of its velocity, but was caught in these buckets and by its weight helped to turn the machine. If the water struck the wheel about halfway up, the device was called a "breast wheel"; if near the top, an "overshot wheel." Water power was early developed by another machine which has since passed out of practical use except for lawn sprinklers. It consists of a series of nozzles, all fastened to a wheel and pointing around the same way. When water is forced through these nozzles, the "kick" of the stream as it issues from them whirls the whole about its axis.

MODERN WATER-POWER PLANTS

As manufacturing became more highly developed, it made greater demands for energy to turn its machines, and man turned naturally to water power because of its cheapness, locating his factories at points where there were waterfalls. The primitive types of water wheel already mentioned were no longer adequate, and in 1827 water turbines were invented which, by means of curved blades fastened to a rotating shaft, used nearly all the energy in the flowing water supplied to them. With the invention of the dynamo, water power could be made into electricity at the waterfall and, by the use of electric transformers



Copyright, Boston Photo News Co.

OLD GRIST MILL AT NEW LONDON, CONN.

Showing the overshot type of water wheel, frequently found in America half a century ago.

and high-tension transmission lines, could be taken to points hundreds of miles away and again changed by motors to mechanical power. Thus the power house can be at some remote and inaccessible point in the mountains and the factory at a convenient site for the manufacture and shipment of goods. This is the feature of hydroelectric development, as it is called, that has made it so widely used at the present time.

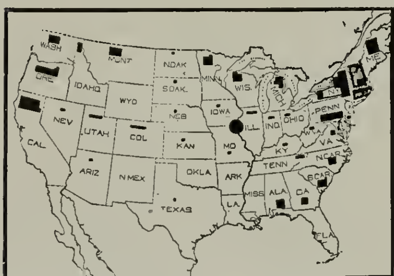
A water-power development consists usually of a dam, which makes a reservoir to store water at some height above the point where it is used, a penstock or pipe to lead the water from the reservoir to the wheel and to deliver it under pressure, gates and machinery for regulating the quantity supplied, the water wheel for extracting the power, and a channel for carrying off the spent water. At the present time water wheels are generally of two types, the turbine already mentioned, which uses a large amount of water with a low fall, or the "impulse" wheel, which uses a small amount with a high fall or "head" and therefore under heavy pressure. If vanes are attached to the rim of a bicycle wheel and a fire hose directed against them, the machine is an example of the impulse-wheel principle.

A GIGANTIC WATER WHEEL

This picture shows the "runner" or rotating part of one of the great turbines, which, with twenty-nine others, furnishes the power which the Mississippi River Power Company turns to electricity and sells in St. Louis, 144 miles away.

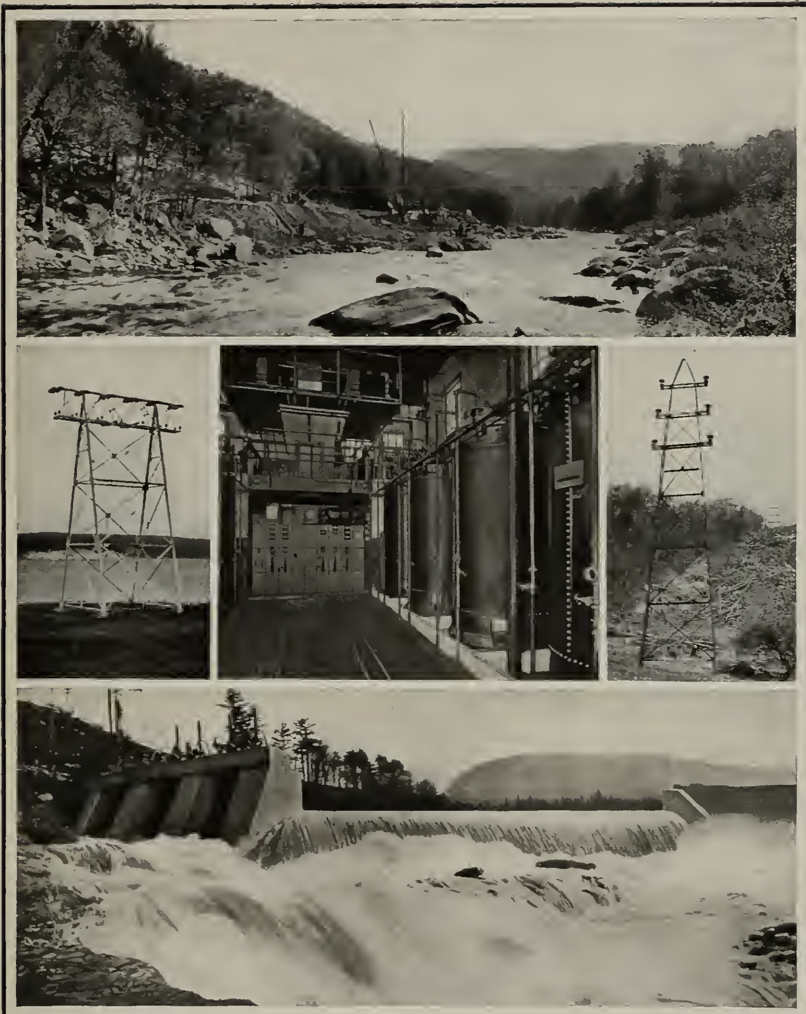
GREAT WATER-POWER DEVELOPMENTS

Opportunity for one of the great power developments of modern times was afforded by Niagara Falls, where the drainage of the Great Lakes pitches over a precipice 159 feet high. The total length of the Niagara River between Lakes Erie and Ontario is thirty-six miles, and in this distance the fall is 326 feet. The first attempt at utilizing the enormous force was in 1861, when a canal was built to take water from the rapids above the falls. It remained unused, because of the Civil War, until 1877, when small water wheels were installed, which utilized but a part of the great head available. Since then, enlargement of the facilities has been almost continuous. Power houses are located on both sides of the river and the water led to their great turbines by extensive canals and tunnels bored from the solid rock. The water wheels are connected to generators, and the current produced is sold to cities and factories more than a hundred miles away, as well as in the immediate neighborhood. It is probable that not much additional power will be developed here, since public opinion has become aroused to the danger of spoiling the beauty of the cataract by robbing it of water.



WATER-POWER DEVELOPMENT IN THE UNITED STATES

The black areas in each state show their comparative water-power developments. The horse power of the single plant of the Mississippi River Power Company, represented by the circle, is greater than the total developed energy of most other states.



Courtesy of N. E. Power Co.

WATER-POWER DEVELOPMENT

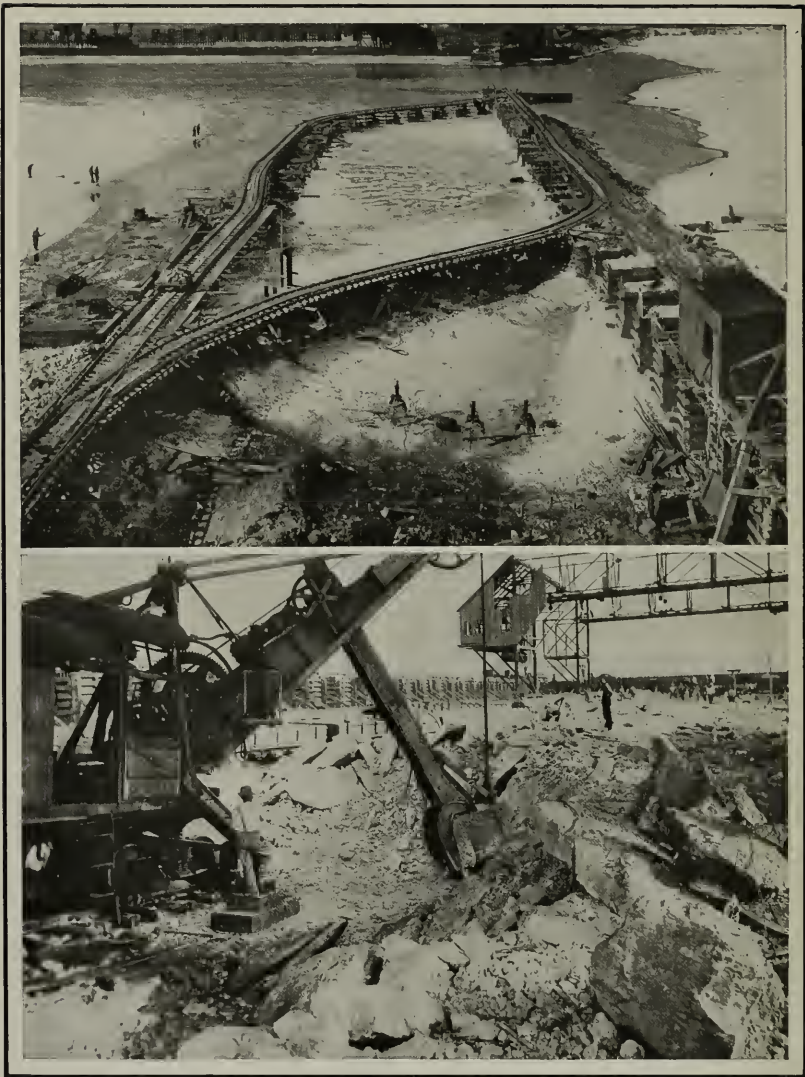
Top: Wasted power. Bottom: Developed power. The dam and head gates for a hydroelectric plant. Middle (left): A transmission line tower holding the electric wires for a very long span over a river. (Right): Type of transmission line tower used under ordinary conditions. (Center): View in a power house.

THE MISSISSIPPI RIVER POWER COMPANY

Top: General view of the works, showing the dry dock, lock, power house, and dam. Note the steamhoat in the lock. Bottom: The upstream side of the lock gates. They may also be seen in the top picture.

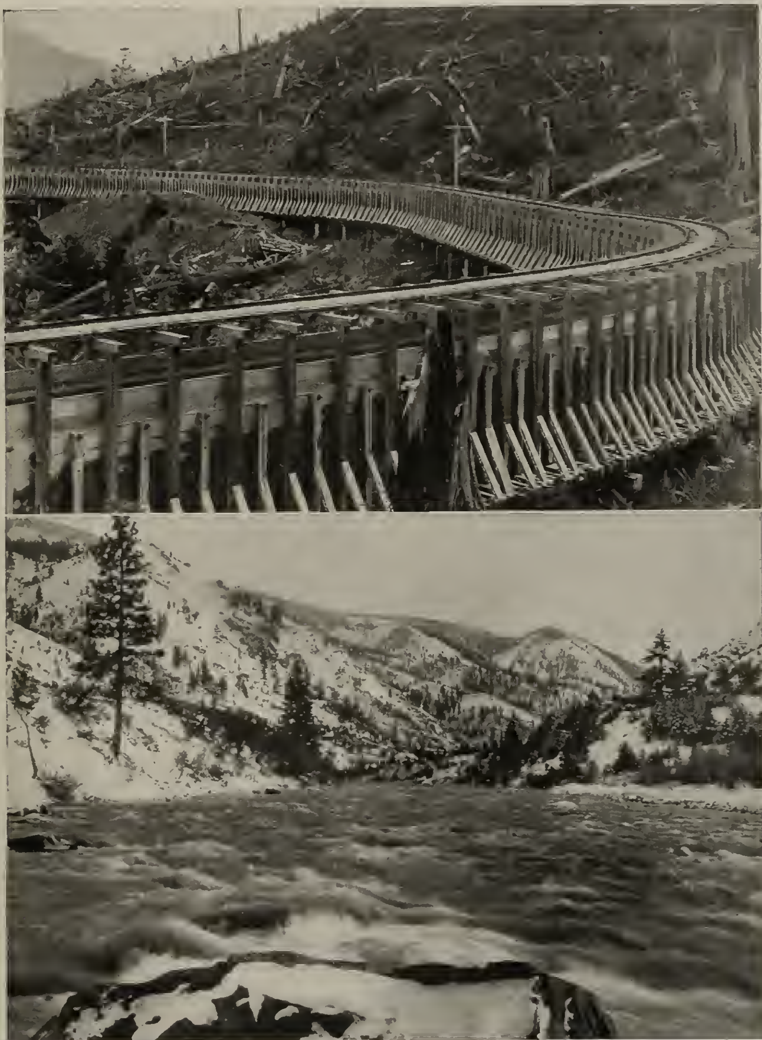
THE MISSISSIPPI RIVER POWER COMPANY

Views showing some of the work in its early stages, and giving an idea of the enormous outlay required for construction equipment.



THE MISSISSIPPI RIVER POWER COMPANY

Top: Construction work, showing a track arrangement for handling material. Bottom: A steam shovel at work.



WATER POWER IN THE WEST

Top: A great wooden trough or "flume" which conveys water for miles. Note the railroad track laid on its top, thereby getting a very satisfactory grade. Bottom: The Truckee River in Nevada, the water of which is used both for irrigation and for power.

Baltimore and its surrounding towns are served by a recent great development on the Susquehanna River at McCall's Ferry. It has a dam almost half a mile long and fifty-three feet high, and ultimately will generate 155,000 horse power.

The absence of coal deposits and the numerous streams in Switzerland have given a great stimulus to water-power development in that country. Their enterprises are remarkable for the very high heads under which the wheels operate.

The greatest recent enterprise in this country is that of the Mississippi River Power Company at Keokuk, Iowa. By means of a dam almost a mile long and a thirty-two-foot head of water, it is planned eventually to develop 300,000 horse power with thirty enormous turbines. The dam holds back a lake sixty-five miles long and from one to three broad, with a depth varying between eight and forty feet. The power house, when complete, will be about one third of a mile long, and in it are the generators making the current, which is carried 144 miles to St. Louis at a pressure of 110,000 volts. The development involved the construction of a steamboat lock at one end as wide as those at Panama and with a greater lift. A huge dry-dock was also built near the lock. The whole work contains 550,000 cubic yards of masonry, to make which required 650,000 barrels of cement. These figures give some idea of the magnitude of the undertaking.

Such great works as these are but the beginning of man's control over the forces of Nature. He is never content with things as they are, but is always anxious to invent and improve and remodel and extend. With science as their aid, his engineers are constantly conquering new ground, but the field of the future has no limit.

Copyright, Boston Photo News Co.

THE COLUMBIA RIVER POWER COMPANY DAM

Note the forms on the face of the concrete work at the nearer end of the structure. Below can be seen the waste sluices through which the river flows during the work of construction.

Copyright, Boston Photo News Co.

PETER BENT BRIGHAM HOSPITAL, BOSTON, MASS.

The modern finely equipped hospital, which places the best of medical care and treatment at the service of rich and poor alike, is one of the greatest medical achievements of recent years.

MODERN MEDICAL PROGRESS

THE science of medicine, like Gaul, divides itself into three parts — diagnosis, treatment, and preventive medicine or hygiene. In plain English these may be translated into (1) What ails you, (2) How to relieve it, and (3) How to prevent its further occurrence to yourself and others. Up to the nineteenth century the second division was by far the best developed; during that time the first grew mightily; and as a natural result the third is now becoming the greatest of all. Advance in medicine has come directly from the great discoveries in the so-called pure sciences, particularly from physics, chemistry, and psychology. For example, electricity has furnished us X-rays; from the telephone came the inspiration for our modern stethoscope; with the microscope, which reached its present perfection about the time of our Civil War, we have discovered and studied what is called the cellular structure of animal and vegetable life, besides that interesting collection of living things known as "germs," which we consider now to be the cause of most of our fevers. Chemistry has refined the useful old drugs and given us many new ones from that mysterious substance, coal tar, and its allies; but, more than that, it has made surgery comparatively painless and, together with the study of germs, it has made germ-free surgery possible. Last, but not least, psychology, the science of mind and thought, has completely revolutionized the old notions of mental disease and is building up to-day a marvelous system of mental healing.

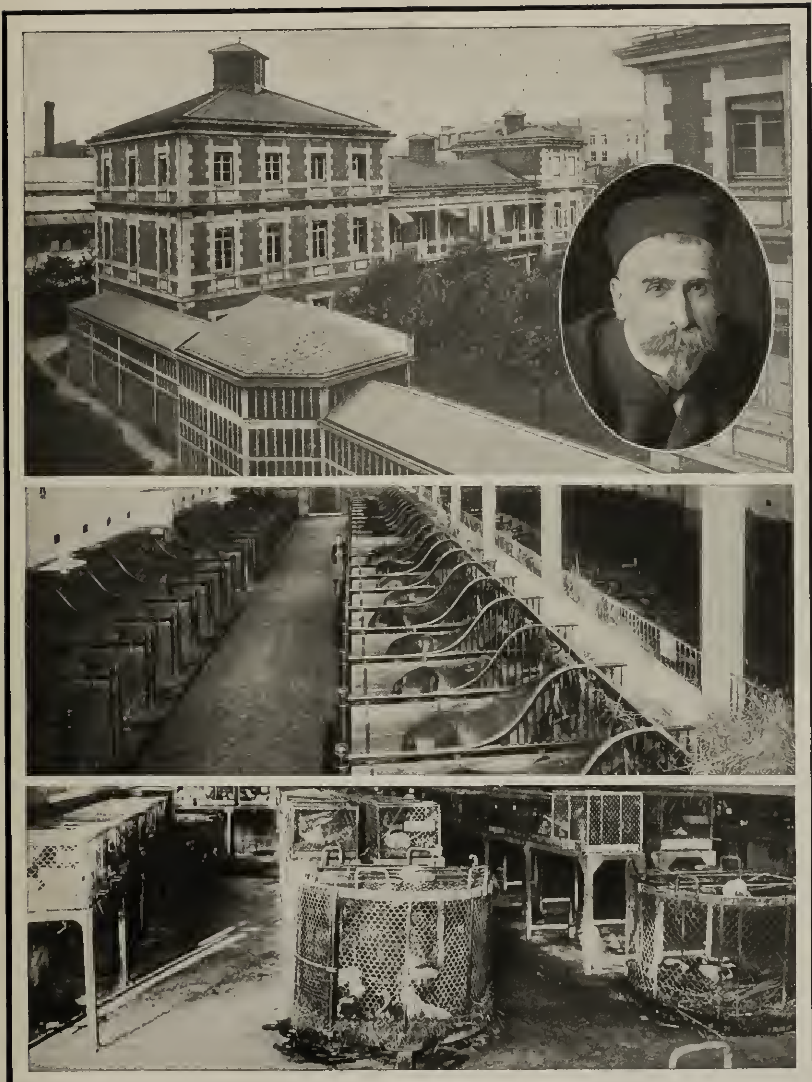
MALARIA, YELLOW FEVER, AND SMALLPOX

One of the most striking changes in medical thought has had to do with malaria. That word used to mean almost anything in the days when the doctor found fever symptoms and did not know what else to call them. But in swampy districts, particularly in the tropics, it meant "fever and ague," "the shakes." Where it was prevalent it was usually considered a necessary part of existence, although for centuries it has been more or less controlled by extracts of Peruvian bark, or quinine. Now, thanks to some patient

Courtesy of the Boston Herald

DR. METCHNIKOFF, SECOND DIRECTOR OF THE PASTEUR INSTITUTE, AND WINNER OF THE NOBEL PRIZE FOR MEDICINE IN 1908, IN HIS LABORATORY

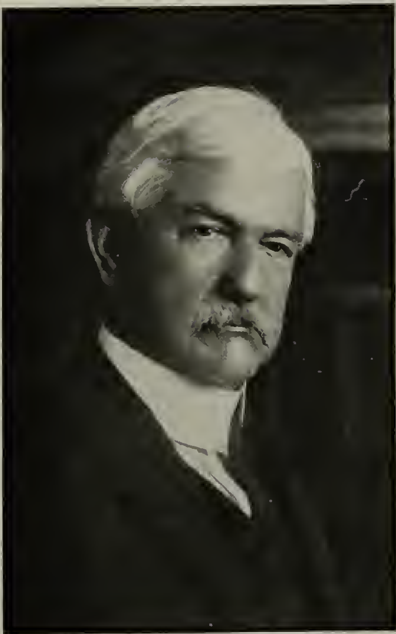
Researches made by Louis Pasteur and his successors have accomplished much in preventive medicine by the study of bacteria.



Courtesy of the Boston Herald

THE PASTEUR INSTITUTE, PARIS

Top: Group of buildings in the Metchnikoff section; Dr. Roux, Director. Middle: Stables where horses are raised from which vaccine is procured. Bottom: Room where guinea pigs are bred for experimentation.



Copyright, Underwood & Underwood

WILLIAM C. GORGAS, SURGEON-GENERAL, U. S. A.

men with microscopes and good imaginations, we know that malaria ("bad air," indeed!) is due to a little parasitic creature's life in our blood, and that it gets into us only via certain mosquitoes and their bites. This explains its close relation to wet land, its occurrence in the spring and fall, and a number of other curious things about it. By draining stagnant places, covering useful bodies of water with oil, and screening ourselves properly, it has become possible literally to wipe malaria out of places where it has been *the* disease for centuries.

Another scourge of the tropics, yellow fever, has been proved to be carried and handed over to its victims by mosquitoes — not the same sorts as those that harbor malaria, but a special variety — and similar measures have wrought a miracle in Cuba and at Panama. Although the germ that causes yellow fever is still unknown, abolition of stagnant water and strict enforcement of screening regulations have made Havana and the Isthmus as free from yellow fever as Pike's Peak. All honor to Reed, who died of the disease while proving its transmission by mosquitoes, and to Colonel Gorgas (now Surgeon-General) of the United States Army Medical Corps, whose skill and persistence have successfully applied the knowledge so dearly bought.

The earliest achievements of the profession are apt to be overlooked in the rush of modern discoveries. It is over a hundred years since vaccination against smallpox was begun, and still we do not know the cause of the disease. We do know, however, how to prevent it, and some day the civilized world will be entirely free from it. In the meantime a disease which once was accepted as a normal part of life, and which still is as common as measles in unvaccinated parts of the world, has become in others a difficult thing to show to medical students.

THE PREVENTION AND CURE OF HYDROPHOBIA

There are several other diseases in the same class — for instance, rabies or hydrophobia. We are exceptionally fortunate in dealing with it, for we can and shall eventually entirely prevent its occurrence; in the meantime we have a sovereign remedy for every case if it is taken in time. The disease — again we do not know the germ — is carried by dogs, and will always kill them in a few months. To get rid of it, therefore, it is only necessary to muzzle *all* dogs in a given section for a given time, say six months, and from that time forward subject all dogs to a quarantine before letting them enter the country. This has been done in England, much to the indignation of travelers who dislike to be separated from their pets, but greatly to the profit of the English dogs and the English people, who have had no rabies for about eighteen years. We in America are handicapped by the long land boundaries which we should have to quarantine and by our natural impatience of governmental restraint. We, therefore, have plenty of mad dogs and plenty of bitten human beings to be cured. The procedure is as follows: When a dog has shown signs of mad-

ness, it is watched and killed, or killed at once, according to circumstances, and the brain is examined in a laboratory. If the disease is proved to be present, all persons bitten or scratched are at once given the Pasteur treatment, named for its discoverer. This consists of inoculation with a "vaccine," or curative fluid made for the purpose from certain parts of the bodies of previously inoculated animals. When it is promptly given, this treatment always prevents the development of the disease; it is of no value when the disease has gone far enough to show itself by symptoms. Untreated, the disease is always fatal.

DIPHTHERIA, MENINGITIS, AND LOCKJAW

Diphtheria (membranous croup) and epidemic meningitis (spotted fever) are diseases with very different manifestations, but similar in this respect: their names used to be spoken with bated breath; now they are practically under control and by very similar means. They are each due to well-known germs, and the nature and workings of these germs have been accurately studied. The methods of cure are not exactly alike in detail, but similar enough in general. The object is accomplished by the use of fluids obtained from animals rendered highly "immune" (resistant) to the germs; these fluids are injected into the bodies of the patients until the disease begins to subside. As for results, diphtheria used to kill about half its victims and cripple half the remainder; meningitis was worse — three fourths died, the other fourth was crippled. Nowadays nobody ought to die of diphtheria, and very few — only those who have been neglected — do. The figures for meningitis are exactly reversed: three fourths recover, most of them very well; one fourth die or are crippled.

Similar work has been done to combat lockjaw, but it has not been as successful. The great attack on lockjaw so far has been on that part of the cases due to fireworks. It is unnecessary to quote figures. The newspapers have published for years the results of "safe and sane" holidays in America; before many years blank-cartridge lockjaw will become a medical curiosity.

VACCINE FOR TYPHOID FEVER

Typhoid fever ought also to become a medical curiosity, but we have not quite reached that point yet. We have known its cause for thirty years; we have known that it came through food and drink and have tried to make them safe for everyone, with excellent results on the whole. But in times of great stress, when water cannot be purified, when floods and earthquakes upset all our pure water and pure milk supplies, and above all, in moving large bodies of persons about in war time, typhoid has claimed its victims in the proportion of five or ten to every one wounded or killed in battle. Now that is all over; soldiers and sailors are given injections of a "vaccine" before going on service at all; doctors and nurses and members of families where typhoid occurs get the same treatment. Another scourge is tamed and likely soon to be wholly eradicated, for typhoid fever is a human disease, and when men have stopped carrying it, should logically die out. The vaccine for typhoid consists of a sort of soup made of water and the dead bodies of millions of typhoid bacilli. It is given by injection under the skin in three or four doses, about a week apart, and protects absolutely for about two years.

TUBERCULOSIS

In the group of "germ diseases" tuberculosis stands alone on account of its frequency and the great amount of attention paid to it both within and without the medical profession. It causes about one seventh of the deaths in the United States; it is found all over the world, in people of all races and ages; in its commonest form it has been known as "consumption," even "galloping consumption," for generations; it has inspired more fear, and more false hope of easy cure, than any other disease. For generations it has been known that it might attack any part of the body; in 1882 Koch demonstrated its cause to be a germ, and so perfect was his description of the natural history of the disease and its transmission that very little has been added during thirty years of research by thousands of men.

There is still a great deal to be learned in the

Copyright, Underwood & Underwood

VIEW IN A HOSPITAL WARD

way of prevention and cure, but this much has been accomplished: in the last half-century the death rate has been materially reduced all over the civilized world; in Massachusetts, for example, just fifty per cent. We have learned, in the first place, that the disease is conveyed directly, either from persons or animals; in the second place, that it is rarely, if ever, inherited, but that the well-known family groups of cases are due to contagion, just as in scarlet fever or measles; in the third place, that most of us catch it at some time or other, but that only a few of us ever show any sign of disease — in other words, that most of us conquer the germs without knowing that they have entered our bodies; in the fourth place, that practically all the cases that develop after infancy are due to improper living conditions — overcrowding, underfeeding, overwork, alcohol, etc. We are, therefore, able to fight successfully against the disease in a dozen different ways, with the net result to date, as stated above, that the disease kills only one half as many people as it used to, and with a complete change in the attitude of the public toward the disease. Formerly the name was a death knell, spoken in whispers and concealed or denied by the patient, who was given up for lost by his friends as soon as his condition was known. At the present time the consumptive, the patient with any kind of tuberculosis, indeed, is a comparatively hopeful, even cheerful person, and he has a right to be.

It is true that a curative serum or "vaccine" has not yet been worked out; the great advance has been on the side of prevention; but one notable step forward in the treatment has been taken — namely, the cure of patients at or near home. For many years a change of climate was thought necessary for success. That is still sometimes the case; but for the last twenty years men have been working out the details of a system of cure that does not depend on the Adirondacks or Colorado, or California or Switzerland, and it is now acknowledged to be a success. Thanks to better medical training, and more intelligent knowledge outside of the doctor's office, we are finding cases earlier in their course, and we are curing a great proportion of them, by right living, in their own neighborhood or at least in their own states. Some day we hope to have a direct medicinal or serum cure; in the meantime there is far more hope for the victim than there was a generation ago. The preventive measures consist in the isolation and education of dan-

gerous patients, with systematic education and inspection of their families; safeguarding milk and food supplies against infection from cattle; and a general campaign against improper housing and neglect of the laws of health. In this way it is hoped that the disease may some day become another medical curiosity.

CLEAN MILK AND DYSENTERY OF INFANTS

Another germ disease that is rapidly disappearing from civilization is the dysentery of infants, which used to come like a plague in warm weather. Once upon a time, not more than fifteen years ago, it was considered a regular event of the terrible "second summer" in every little life; to-day it is a comparative rarity. Many a busy doctor does not see a case for three or four summers. The disease is a fever, due to germs. Formerly the milk sold in cities was full of germs of all kinds, including the specially vindictive ones of dysentery. Now we are getting comparatively clean, safe milk, and what dysentery we see comes from an occasional contaminated bottle or by contagion.

THE HOOKWORM DISEASE

Who has not heard of the "poor white" or of the laziness and shiftlessness of himself and his family? But who would have thought, twenty years ago, that Uncle Sam would be treating him by wholesale for a disease that has made him for generations what he is? That is going on, however, in the Southern states to-day. The poor, miserable, stupid, anæmic portion of the population has been found to be suffering en masse with a parasitic disease which is curable, and whose cure makes the victim over completely. The disease is caused by a little worm which lives in the bowels and poisons the victim, making him pale, thin, and mentally backward, often

WEIGHING THE BABY

to an extreme degree. A short treatment with a simple, inexpensive drug drives out the worm and restores the individual to useful society. This treatment is now being systematically carried out by Dr. Stiles, working under a great Foundation throughout the Southern states. No one can yet foretell the changes which it is expected soon to make.

PLAGUE

No description of the triumphs of preventive medicine ought to omit our freedom from "plague," the pestilence that walks in darkness, the great widespread horror of medical history. Some of the great plagues of history have been cholera, the weapon for which is modern quarantine; it always travels by water and should not be hard to control. *The* plague, the "black death" of the Middle Ages, is another matter. We know now that, aside from human carriers — already the victims of disease and easy to isolate — the really insidious transmission that has puzzled quarantine experts for many years is through infected rats and, in California, infected ground squirrels. In darkest Asia plague always exists; so far as we can see it probably will for centuries to come. But with our new knowledge it ought never again to sweep like a forest fire over Europe or the western world.

THREE MEDICAL INSTRUMENTS

So far we have considered the conquest of diseases due to germs as it has been wrought with the aid of the microscope. The stethoscope, or wireless telephone for listening to the sounds within the body, has been mentioned. A third instrument, with an even longer and more jaw-breaking name, has come into general medical use very recently. Already it has materially changed the medical view of certain diseases, and it is still in its infancy — namely, the sphygmomanometer (!) or blood-pressure machine. This instrument was devised to measure the strength of the heart's action; it has become one of our best guides to the condition of the kidneys and the whole system of blood vessels as well. There are two forms in common use, both of which set the heart's action as expressed in the wave of blood which we call the pulse over against a measured resisting force, either a steel spring or a column of mercury. Without going into too much detail, it may be said that in the last ten years our whole conception of diseases of the circulation, popularly known as Bright's disease, hardening of the arteries, etc., has been revised by this one instrument. Moreover, it has furnished our very best danger signal against convulsions in pregnancy, collapse in certain fevers, etc. Life-insurance companies have been saved thousands of dollars by its use and are requiring this test as part of the routine examination before all sizable policies are issued.

THE MODERN CHEMIST AND HIS DRUGS

So much for physics; now a word for chemistry. Of course we have new drugs, and even the old ones differ, not only in taste but also in strength and definite action, from those of our fathers. A long chapter might be written on the marvels of modern drug chemistry — the making of old substances from new and strange materials, and the discovery by accident or design of new articles of value. Some of the newest drugs have been worked out from formulæ on paper before they were ever made in the laboratory. The chemist actually decided what he wanted the drug to do and then built up a chemical salt — not a mixture, but a real single thing — that would fill the bill.

One drug that has grown enormously popular in the last ten years was discovered rather romantically. In European countries the use of preservatives in beverages has been strictly forbidden for many years. It was noticed that the wine from a certain district in Austria began to have a notable laxative effect. The government quietly made an investigation and found that the growers were all using as a preservative a well-known coal-tar chemical, employed for many years in every laboratory in certain color tests, where it turned a bright pink. The wine growers were punished and the practice stopped. The affair was published, however, and attracted the attention of an enterprising drug manufacturer, who at once put the chemical on the market as a new laxative, at an enormous profit. It works well

and is very cheap; to-day there is not a wholesale drug house that does not stock a pink laxative tablet under some ornamental name or other.

ANÆSTHESIA AND ANTISEPSIS

The other two great debts which we owe chemistry are in the realm of surgery. First came anæsthesia — unconsciousness to pain — human race; one simply shudders at what went on before and is thankful to belong to his own generation. From a technical point of view anæsthesia greatly extended the possibilities of surgery, making impossible things possible.

Thirty years later came Lord Lister and the first breath of antisepsis — "war on germs in surgery" — which has made modern operative surgery possible. The original idea was death

MONUMENT TO DR. MORTON, THE DISCOVERER OF ETHER, BOSTON, MASS.

attained in America and England with similar but different drugs almost at the same time, developing little by little with the addition of laughing gas and later of the "local anæsthetics" of the cocaine group, which stupefy part of the body only. It is scarcely necessary to mention what anæsthesia has done for the to the germ by chemical means only. Operations were carried on in a mist of carbolic acid sprayed from different directions; that was "Listerism," "antisepsis." Gradually the idea of working without germs so far as possible, "asepsis," grew and spread, until now it is the principal object of the surgeon's

Copyright, Underwood & Underwood

DR. ALEXIS CARREL

Director of the Rockefeller Institute for Medical Research, and winner of a Nobel prize of $40,000, in recognition of his distinguished service for the advancement of surgical science.

work. For no matter how skillful his cutting and tying, if he leaves germs behind they will grow and ruin his work. At present antiseptics are used only for cleaning the skin of the parts to be worked upon and the room in which the work is done; the instruments and clothing, both of the patient and the operators, are sterilized beforehand; that is, made germ free by baking or boiling. All serious operations are done with rubber gloves, because gloves can be boiled — hands cannot. As a result of these two factors — unconsciousness to pain and cleanliness — practically all parts of the body are entered with impunity, and work can be done that would surely have been called witchcraft in witchcraft's day.

SURGICAL TRIUMPHS

Probably the commonest serious surgical operation to-day, certainly the one most discussed, is that for appendicitis. People say, "What is this appendicitis? Our grandparents never had it." Yes, they did! Inflammation of the bowels; there is scarcely a family that cannot say that some grandfather or great-aunt "died of inflammation of the bowels." Not quite thirty years ago Dr. Fitz of Boston described the condition accurately and persuaded some of his surgical friends to operate for its relief. At first they simply drained abscesses; soon they were removing the inflamed appendix from the middle of the abscess; now they do their best to get it out before it makes an abscess at all. And famous surgeons tell of their five hundred, their thousand operations without a death! The profession is not ashamed of its appendicitis record.

The next most-discussed operation is surely

X-RAY PHOTOGRAPH SHOWING PIN IN CHILD'S STOMACH

the removal of tonsils and adenoids. This is another operation of which our forefathers never dreamed, but the difficulties which lead up to it are common enough now. Most of us are familiar with the typical adenoid face with its open mouth, vacant stare, and frequently its history of running ears every winter. When large adenoids are removed, the improvement in the child is as marked as any change can be.

A third wonderful advance in surgery has been made with very little operating and very little blowing of trumpets. The modern treatment of tuberculosis of joints — the actual cure of beginning humpbacks and hip disease — is a great triumph. Not more than a generation ago treatment of hip and spine disease with plaster of Paris and braces began. Up to that time hideously deformed cripples were growing up all over the world, and nobody expected anything else. But one man invented one form of apparatus, and another added a little here and there, each one trying to keep the little soft child's body straight until the disease was conquered and the body grew stronger. If a case is seen in good season, there is excellent hope that the child will grow up with a strong, straight back or a leg that does not limp so that it is noticeable.

BONY STRUCTURE IN DEFORMED LEG SHOWN BY X-RAYS

MENTAL HEALING

It would not be fair to confine our attention wholly to disease of the body; something should be said regarding the mind. This is not the place to discuss insanity or drug habits, but "nervous prostration" and kindred states deserve a word. In this generation certain very clear thinkers have studied mental breakdowns and defects with great care, and have devised methods of finding out what is the matter with a sick mind which are fully equal to those used on the body. By skillful conversation with the patient the doctor sifts out the real cause of disturbance, often of very long standing, and is frequently able to cure it by showing the patient what has given him his unnatural feelings. This is the basis of all true mental healing: "Ye shall know the truth, and the truth shall make you free." The science of mental disorder and the art of healing it are yet in their infancy; the next generation will probably take them as matters of course, as we do vaccination and antitoxin.

THE FUTURE

What have we a right to expect in the near future? Who knows? Earnest, skillful men are working everywhere in surprisingly large numbers and surprisingly many directions. We need a better cure for cancer than the operation; we need a real weapon to fight pneumonia, the "Captain of the Army of Death"; we need urgently a defense against rheumatic fever, one of the commonest and most damaging fevers of childhood. Gradually the clouds of mystery are lifting. Some have been rolled away; others will be in the future.

Copyright, Boston Photo News Co.

CHILDREN IN A FREE DENTAL CLINIC

A WORD ABOUT DENTISTRY

IN an account of the advance made in dentistry in the past twenty-five years first place should be given to the education of the public by the dentist to a realization of the importance of oral hygiene and preventive measures, in the case of children's teeth in particular. The compulsory examination in the schools at stated intervals, with the suggestion that any abnormal condition be immediately attended to, the provision for free treatment of teeth of children whose parents cannot afford to pay, and the education of the children themselves in the importance of keeping their teeth clean and in good condition have improved to a remarkable degree the mental as well as the physical condition of the average American.

REMOVING NERVES

Another great improvement to be noted is the direct method of removing nerves, when necessary. The old way was to put arsenic in the teeth under a temporary filling for twenty-four hours—a method often attended with much pain; at the end of that time to remove as much of the nerve as possible and give another treatment, and so on until the nerve was all out and the canal ready to fill. To-day novocain is forced into the nerve structure by pressure, and the nerve taken out at once, the operation being attended by practically no pain. A dressing is then put in, and at the next appointment, in the great majority of cases, the tooth is ready to fill.

ARTIFICIAL TEETH

Artificial teeth (plates) twenty-five years ago were made on a model set on an articulator which simply opened and shut. To-day the anatomical dentures are arranged on a model which is on an articulator capable of all the movements of the human jaw, thereby giving the patient a much more perfect occlusion, much more comfort, and last but not least, a wonderfully natural appearance. With the old-style bridge work it was practically impossible, if one of the porcelain teeth broke, properly to repair it without removing the entire bridge, a painful and expensive operation. In consequence, the cutting edge of the porcelain tooth had to be protected by extending the gold backing down over it, the appearance of this leaving much to be desired. At the present time the various teeth of a piece of bridge work, the foundation of which is still gold, are all porcelain, and each tooth is cemented into place separately like a porcelain crown. No gold shows at all, and in case of accident any of the teeth can be replaced in a short time without disturbing the bridge.

The dental operations made possible without pain or discomfort, by the use of nitrous oxide and oxygen, with the patient conscious but insensible of pain, is another very important step in advance, and at the present time this method is being used with great success by most dentists.

LABORATORY FOR CHEMICAL RESEARCH, HARVARD UNIVERSITY

RECENT SCIENTIFIC PROGRESS

THE object of science is to discover truth, to accumulate and systematize our knowledge of Nature and of natural phenomena; in other words, science is classified knowledge. The geologist endeavors to learn all that he can about the earth, its composition and structure, and the processes that have gone on through the ages to form our rocks and minerals. The astronomer studies the stars and planets with his telescope and calculates the motions and orbits of the heavenly bodies; his is a science of the infinitely great. The chemist, on the other hand, investigates the infinitely little; his powerful microscope probes the composition and behavior of the smallest particles of matter and their relations to each other.

Whenever these investigators and searchers for truth succeed in learning more facts about Nature and in using these facts for the benefit of mankind, we call such success scientific progress.

Some of the most highly important and practical discoveries of modern times have been made by men who were merely in search of additional scientific truths. When Sir William Crookes, for example, first began his laborious experiments upon the effect of the discharge of an electric current through rarefied gases, no one would have imagined that his labors would lead to results of practical value. Yet to these painstaking investigations we owe the discovery of the X-rays, with their everyday application in medicine and surgery and their wonderful value in the cure of disease and the saving of human life. And this pioneer work of Sir William Crookes also gave the world its first inkling of radioactivity, a glimpse of the tremendous source of energy locked up in the infinitesimal atoms of matter, now so plainly

Copyright, Boston Photo News Co.

SIR WILLIAM CROOKES

Pioneer in the field of radioactivity.

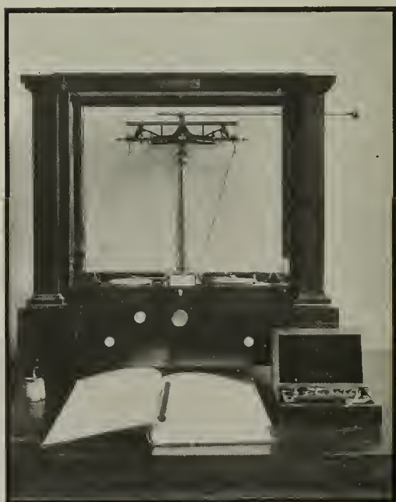
revealed by the mysterious energy given out by radium and other radioactive substances.

No other generation has seen such wonderful scientific progress as the present. Let us name some of the most notable discoveries of recent years. The list is a long one, but a few of the most remarkable include the X-ray; radium and its allied substances; the wireless telegraph; antiseptics and antitoxins; the exact measurement of a light wave to the millionth of an inch; the discovery of five new gases in the atmosphere, helium, neon, krypton, xynon, and niton; the conversion of carbon into diamond and graphite by electricity; the production of aluminum; the electric furnace; and the products of synthetic chemistry.

RADIUM: THE MODERN WONDER OF WONDERS

Men of science themselves consider the discovery of radioactivity and of the element radium to be perhaps the most important and astonishing that has ever been made, for this discovery has completely changed all the old explanations of the structure of matter.

Sir William Crookes's investigations of the action of an electric current when passed through a glass tube containing various kinds of gases led to the discovery by Röntgen of the X-rays, so called because their exact nature was unknown. In his search for additional scientific truths, M. Henri Becquerel endeavored to find out whether other phosphorescent bodies besides the glowing X-ray tubes could produce penetrating rays. There is a somewhat rare element, called "uranium," which possesses a phosphorescent action, and M. Becquerel decided to investigate its properties. He wrapped a photographic plate in black paper and placed on it a bit of copper in the form of a cross, covering the metal with



BALANCE FOR ACCURATE SCIENTIFIC WORK

On this balance, photographed in the laboratory shown on the preceding page, weights can be determined to $\frac{1}{100}$ milligram or less than $\frac{1}{2,800,000}$ ounce, a value so small that the smallest weight actually handled in the process is one thousand times as beavy. This suggests the extreme care and accuracy which the chemist must employ even in such an apparently simple process as determining the purity of a sample of iron ore.

Copyright, Underwood & Underwood

RADIUM IN ITS NATURAL STATE

Top: Paradox Valley, Colorado, looking toward the La Sal Mountains, where the world's greatest radium discoveries have been made. Middle: Bags filled with carnotite ore, from which radium is extracted, ready for shipment. Bottom: Specimens of carnotite ore, of which it takes hundreds of tons to produce a few milligrams of radium.

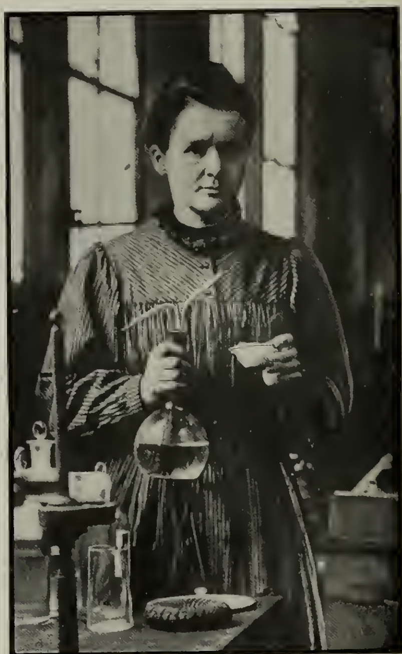
PROFESSOR PIERRE CURIE

some uranium salt. When the plate was developed, a few hours later, the image of the cross was found upon the negative.

This result started a search for an element capable of emitting still more powerful rays, and after much labor Professor Pierre Curie and his wife, Mme. Sklodowska Curie, discovered that pitchblende has a radioactivity four times as powerful as that of uranium. This fact convinced them that the radioactivity of the uranium salts was not due to uranium itself, but to some other element. After a long series of investigations and almost endless chemical processes, the Curies at last succeeded in isolating a radioactive salt that was found to have no less than 1,800,000 times the activity of Becquerel's sample of uranium. This radioactive salt was chloride of radium. How long and how hard a task was theirs can be understood from the fact that from their original single ton of pitchblende ore they finally obtained only the hundredth of a gram — one seventh of a grain — of radium salt — the most precious and marvelous powder ever produced.

"The wonder of this powder," says Professor E. Ray Lankester, "incessantly and without loss, under any and all conditions pouring forth by virtue of its own intrinsic property powerful rays capable of penetrating opaque bodies and of exciting phosphorescence and acting on photographic plates, can perhaps be realized when we reflect that it is as marvelous as though we should dig up a stone which, without external influence or change, continually poured forth light or heat, manufacturing both in itself, and not only continuing to do so without appreciable loss or change, but necessarily having always done so for countless ages while sunk beyond the ken of man in the bowels of the earth."

Radium gives out enough heat to melt rather more than its own weight of ice every hour;



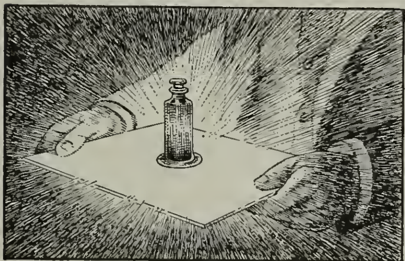
MME. CURIE IN HER LABORATORY

Copyright, Underwood & Underwood

THE MANUFACTURE OF RADIUM

On this page are shown the factory in Pennsylvania where radium is manufactured, the sacks containing carnotite ore as they are opened, the vats where the precious metal is precipitated and the sand and iron ore are eliminated, and a chemist making the final electroscopic test for radium.

enough heat in one hour to raise its own weight of water from the freezing point to the boiling point, and while it does lose some of its atoms in the process, the number is so small that after the passage of 1760 years only half of them will be destroyed. If the sun contains a fraction of one per cent of radium, the presence of the element will account for and make good the heat that is continually lost by it. And if only a small amount of radium is scattered through the surface of the earth, it will



RADIUM CAUSING PHOSPHORESCENCE

Radium, itself nonluminous, is here held on a screen made of a sensitive substance which it causes to give out light.

be enough to maintain the temperature of our globe against all loss by radiation.

RADIUM AND THE AGE OF THE EARTH

This fact alone has made it necessary to revise all the estimates as to the age of the earth. Up to this time geologists have believed that the surface of the earth has enjoyed the same temperature as at present for some thousand million years. The physicists, however, have estimated the age of the earth to be from ten to one hundred million years, basing their estimates upon the rate of cooling of a sphere of the size and composition of the earth. The discovery of radium, however, proves that the earth's material is not self-cooling, but self-heating.

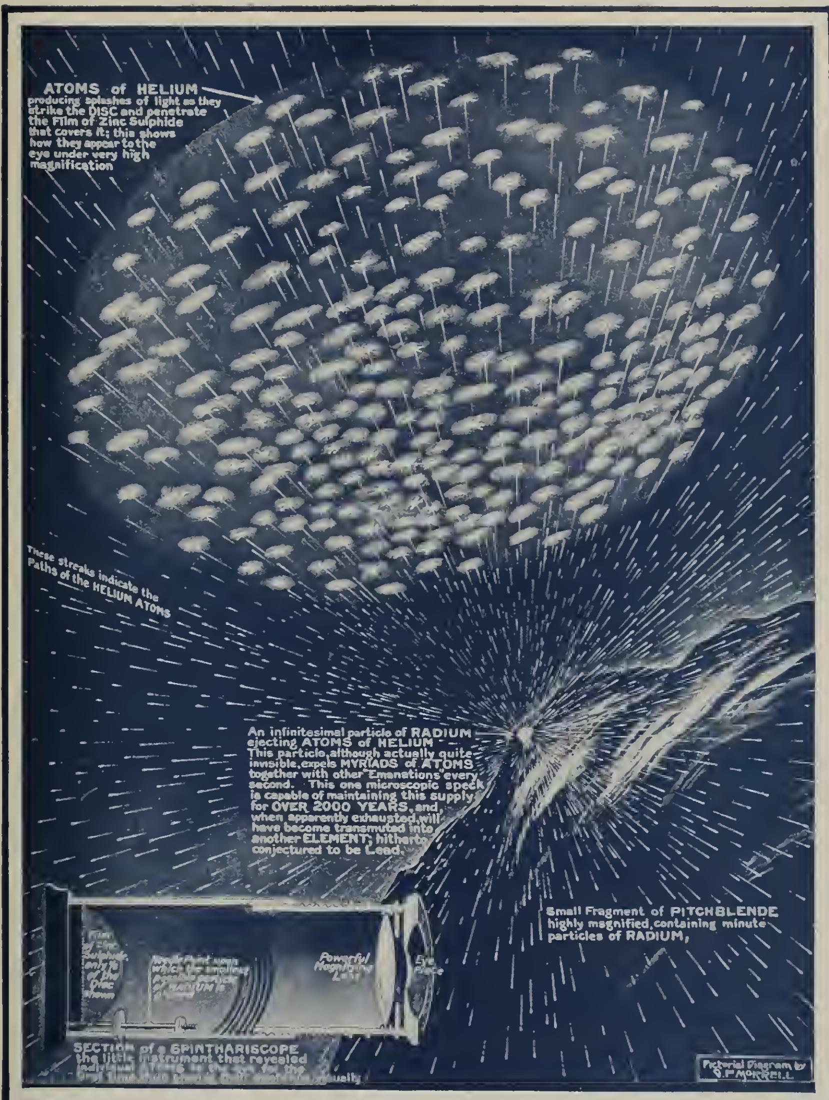
When radium and certain other radioactive substances are dissolved in water, they produce a peculiar emanation, or gas, which changes in a few days, in part, into helium, a light gas that exists in great quantities in the sun. As the presence of helium would indicate the previous presence of radium, this fact proves the existence of large amounts of radium in the sun, and would account for that body's apparently inexhaustible production of heat. Helium, too, has been found in most hot springs and in many radioactive minerals in the earth, so that we may conclude that the earth itself contains no small amount of the mysterious element.

Radium and other radioactive elements are peculiarly unstable; that is to say, their atoms are constantly giving off energy, or heat, at a tremendous rate, over one hundred thousand miles a second. How fast this is can be realized from the fact that a modern rifle bullet travels less than half a mile a second. Scientists are now convinced that these elements are not the only ones which possess this extraordinary and practically imperishable energy. They believe that the calcium in gypsum, the sodium in common salt, and many other elements have this tremendous force. As Sir William Ramsay has said, "If some form of catalyzer (or key) could be discovered which would increase their inconceivably slow rate of change, then it is not too much to say that the whole future of our race would be altered." Many men of science believe that this secret will some day be discovered and that men will eventually be able to tap these now unfamiliar stores of energy and apply them to the future needs of humanity.

SCIENCE IN INDUSTRY

Let us now consider some of the more practical applications of science to industry, which will show the direct dependence of many modern industrial processes upon the progress of science and the discoveries of laboratory workers.

Take, for example, the industry of incandescent gas mantles. In 1885 the German chemist Von Welsbach, while investigating certain rare metals of the thorium group, discovered that the oxide of thorium produced an intense light when heated in the flame of a Bunsen burner. This led him to soak a filament of cotton in a solution of thorium nitrate and to try the effect of heating this



THE FLIGHT OF THE ATOM: RADIO-ACTIVITY MADE VISIBLE

This pictorial diagram shows how the flight of an atom is seen through the spinthariscope.

in the nonluminous flame. The cotton burned away, leaving a shell of thorium oxide which glowed with intense brilliancy when heated. This discovery brought about the manufacture of the now familiar and universal gas mantle, which is made by dipping a small cotton or ramie fiber stocking in a solution of thorium and cerium oxide. No less than one hundred and fifty millions of these mantles are now manufactured in one year in Germany alone. It is interesting to note that a substance called "mesothorium," which possesses many of the properties of radium, is derived from the waste thorium of the gas-mantle factories.

FERTILIZERS BY ELECTRICITY

Chemists have long sought for some method of making use of the nitrogen in the atmosphere. Until very lately nearly all the nitric acid and nitrates used in the arts and by farmers for fertilizing their fields came from the nitrate beds of Chile. Over two million tons of nitrate are obtained from these deposits every year, and it is estimated that the beds will be exhausted within thirty years. Three fourths of this nitrate is used to make chemical manures, and without these fertilizers it would be difficult, or utterly impossible, to produce sufficient wheat and other foods to meet the demands of the world's population. The chemist therefore attacked the problem of converting some of the inexhaustible store of nitrogen in the atmosphere into nitric acid. The problem was solved by means of electricity. Air is blown into a powerful electrical discharge, or electric arc, where it is heated for an instant to an enormous temperature and later, on leaving the arc, is cooled as quickly as possible. While in the arc, the nitrogen and oxygen in the air combine to a certain extent, and the mixture is cooled so quickly that it does not have time to disunite. The nitrogen oxides thus secured are drawn through water, and the solution of nitric acid is run upon soda to produce sodium nitrate, or upon lime to produce calcium nitrate, which is also called "Norwegian saltpeter." These fertilizers fully equal the natural Chilean salts. The cheap production of nitrates is possible wherever sufficient water power can be had to generate electricity at low cost. Norway has enormous water power, and large manufactories in that country now produce artificial nitrates upon an immense scale. Electrochemistry has thus come to the aid of the farmer, and the world need no longer fear any lessening in the bountiful harvests that it now enjoys.

APPLIED SCIENCE AT NIAGARA FALLS

One of the most interesting places in the world to study the results of applied science is the great manufacturing district that now centers about Niagara Falls, where the tremendous electric energy produced by almost unlimited water power has been harnessed for the benefit of mankind.

Most of the industrial processes carried on at Niagara make use of the electric furnace. This generates heat within itself without combustion and produces temperatures that far exceed those obtainable from furnaces using fuel. The limit of the temperature of the electric furnace is about 6692° F., the temperature at which the carbon lining of the furnace boils away. This is three times as high as the melting point of cast iron. The electric furnace is also highly efficient, as from fifty to seventy-five per cent of all the heat developed can be applied, a far larger proportion than is the case with fuel-fired furnaces.

Aluminum is the most useful of the light metals. It is found more abundantly in Nature than iron; yet until a way was found to manufacture it electrically the metal cost nearly a dollar a pound. In 1889 an American chemist, Mr. Charles M. Hall, discovered that aluminum oxide could be easily dissolved in certain salts — double fluoride of aluminum and the alkali metals — and that the passage of an electric current through this solution, when heated and fused, produced pure aluminum. In 1912 the market price of the metal was twenty-two cents, and the total production sixty-five million pounds.

HOW ACETYLENE WAS DISCOVERED

Calcium carbide is the product of another American inventor and is now manufactured in great quantities at Niagara Falls. In the

course of some experiments with the electric furnace, Mr. Thomas Willson heated a mixture of coke and lime in the hope of producing metallic calcium. On opening the furnace he found a gray, fusible mass which contained no metallic calcium and seemed to be of little value.

From Current Mechanics

WELDING BY OXYACETYLENE FLAME

The welding of these two hard-steel files was completed in five and three fourths seconds. The men holding the files stated that they felt no heat.

Mr. Willson removed the block of matter and threw it into a bucket of water. Torrents of an evil-smelling gas at once appeared, which, on examination, was found to burn with a brilliant flame and was soon identified as almost pure acetylene. Few of us realize how widely that gas is now used, not only for lighting the lamps of automobiles, bicycles, trains, houses, and towns, but also for the welding of metals by oxyacetylene flame.

CARBORUNDUM

The most efficient polishing material and one of the hardest abrasives in the world was unknown a few years ago. Now carborundum is extensively employed as a substitute for emery in whetstones and grinding wheels. This, too, was discovered by an American, Mr. Charles E. Acheson. It is made by heating a mixture of sand and carbon to the temperature of the electric arc, and is a dark, crystalline substance, the surface of which is noticeably irridescent. Mr. Acheson is also the inventor of artificial graphite, which is a product of the electric furnace. No other temperature is sufficiently high to convert ordinary carbon into the soft, slippery graphite, which is even superior to the natural product found in Ceylon and Siberia. Graphite is used largely for lubricating machinery.

In addition to the products described, the electrochemist has been responsible for the development at Niagara of the production of metallic sodium, chlorine and caustic soda, electrolytic chlorates and alundum, and the ferro-alloys. These last are alloys of iron with the more expensive metals, used in manufacturing steels of various kinds. Some of these metals are nickel, tungsten, molybdenum, boron, uranium, and vanadium. They are made into fine tool steels, automobile axles, gun plate, and gun steel.

The chemist has succeeded, too, in obtaining high temperatures by other means than electricity. The new thermit process easily produces temperatures at which iron runs like water. By igniting a simple mixture of aluminum powder and iron oxide, enormous heat is produced, and the mixture soon glows with a fierce light, producing liquid iron and a slag of alumina. No cumbersome apparatus is required, and by this new method it is possible to weld fractures in machinery that is difficult of access, such as the broken propeller shafts of steamships, without loss of time. Thermit generates highly pure iron, and when the oxides of certain other metals are used, such metals as chromium, tungsten, manganese, vanadium, and tantalum can be prepared in a much purer state than is possible in any other way.

The electric furnace is now used in the manufacture of iron and steel, where fuel is expensive and power is cheap, and experts say that the product is far superior to the metal produced by older methods.

CELLULOSE AND ITS USES

One of the most common substances in Nature is cellulose. Cotton and linen are composed entirely of it, and it forms the chief constituent of the fibers of plants and

Copyright, Underwood & Underwood

INCREASING THE VALUE OF WOOD BY SCIENTIFIC PROCESSES

A striking example of the transformation of a raw product, wood, into a finished article of commerce, paper, made possible through scientific discoveries.

trees. The chemist has made any number of wonderful things from this universal substance, including paper, collodion, celluloid, photographic and motion-picture films, smokeless powder, and artificial silk, hair, and leather.

We have a striking example of the way the man of science can transform cheap raw materials into articles of value, when we consider ordinary wood. By the cord it is worth about ten dollars, or half a cent a pound. Mr. Arthur D. Little shows that in the form of chemical fiber for paper making half the weight is lost, but the remainder is worth two and a quarter cents a pound. As paper it is sold at four cents. Made into artificial silk by more refined chemical processes, it commands two dollars a pound, and as cellulose acetate bristles it is worth four dollars a pound.

Everyone knows the shiny, silklike fabric called "mercerized cotton." Chemists discovered that when cotton fiber was soaked in an alkaline solution it took on a lustrous and resistant surface. When a small amount of carbon bisulphide is added to the solution, the cotton fibers dissolve into a thick, tough liquid which, when forced through tiny openings in glass, coagulate into tough threads. These threads can be spun and woven into fabrics that closely resemble silk. The new process is so cheap that it is believed that these fabrics will eventually entirely replace the expensive natural silks.

So many millions of feet of celluloid film are now used in the motion-picture apparatus that chemists have at once seen the need of a film that cannot burn. The ordinary celluloid film is highly inflammable, but chemistry has solved the problem again, and a noninflammable film made from acetate of cellulose is now almost universally used.

THE ROMANCE OF SCIENTIFIC DISCOVERY

We have spoken of the accidental discovery of helpful or valuable products by men of science when engaged in the search for truths alone. This is well illustrated by Professor Ira Remsen's account of the way he discovered the compound known as "saccharin": "Nearly twenty-five years ago, in the laboratory under my charge, an investigation was being carried on that seemed as little likely to lead to practical results as any that could well be imagined. It would be quite out of the question to explain what we were trying to do. Any practical man would unhesitatingly have condemned the work as being utterly useless, and I may add that some did condemn it. There was no hope, no thought, entertained by us that anything practical would come of it. But lo! one day it appeared that one of the substances discovered in the course of the investigation is the sweetest thing on earth; and then it was shown that it can be taken into the system without injury; and, finally, that it can be manufactured at such a price as to furnish sweetness at a cheaper rate than it is furnished by the sugar cane or the beet. And soon a great demand for it was created, and today it is manufactured in surprising quantities and used extensively in all corners of the globe." Saccharin, which is said to be five hundred times sweeter than cane sugar, is made from certain products of coal tar, and for that reason has been called "the honey of prehistoric bees." It is chiefly used by diabetics, who must abstain from the use of sugar, as it passes through the body unchanged.

Our space is not sufficient for the wonderful story of the products of coal tar. German chemists now manufacture from this unpromising material hundreds of dyes, purer in composition and color than natural dyestuffs and considerably less expensive.

Artificial camphor, artificial perfumes, the alkaloid drugs, and many other substances are made in the laboratory, and men of science tell us that some day the workshop may even furnish some of our foods.

Everywhere we see evidences of the debt that the world owes to the painstaking investigator and seeker for knowledge. Their achievements have given us the steam engine, the gasoline motor, wireless telegraphy, the telephone, and aëroplane, medicines, dyestuffs, and countless other necessities. Their work has added immeasurably to the world's store of knowledge. We may well believe that scientific investigation will one day solve many of the problems that now seem so baffling, and thus contribute to a still greater extent to the progress of humanity.